THE AEROPLANE and ASTRONAUTICS

MARCH 18, 1960

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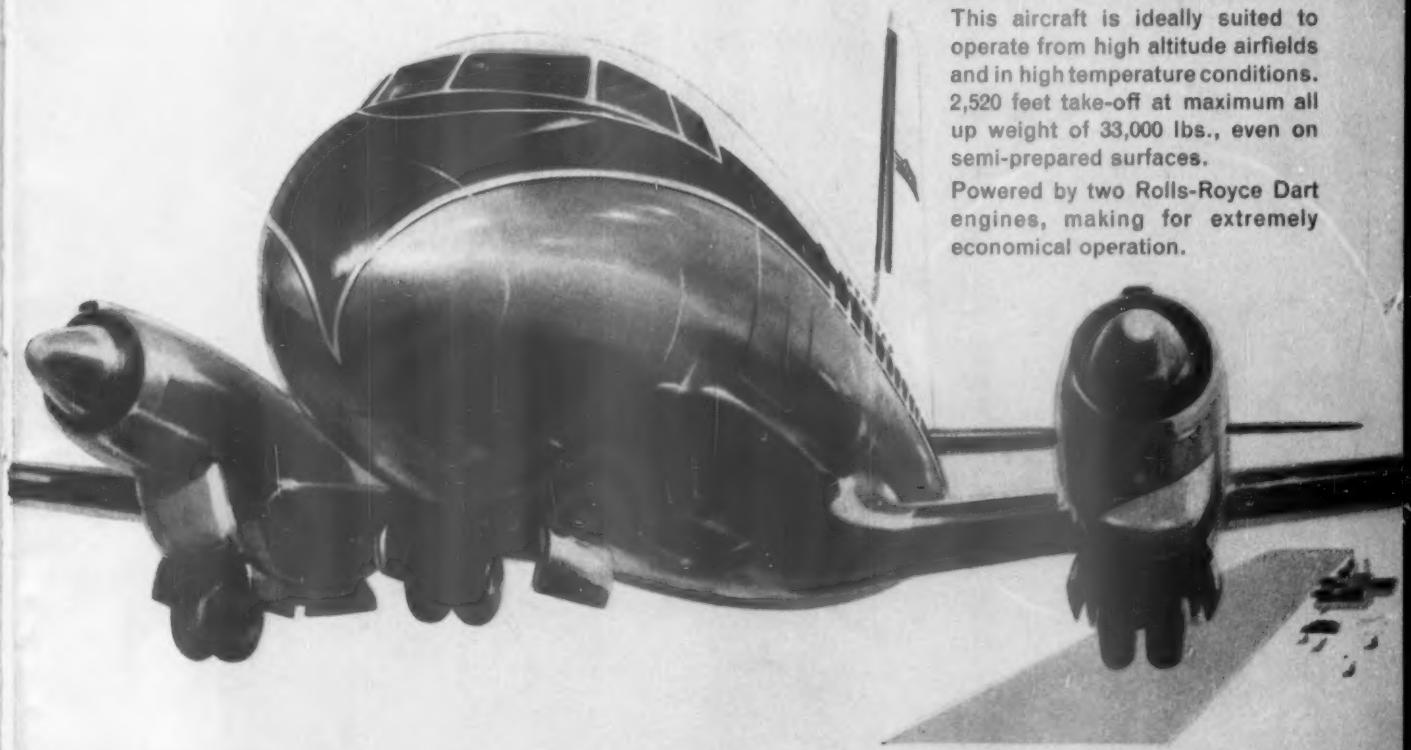

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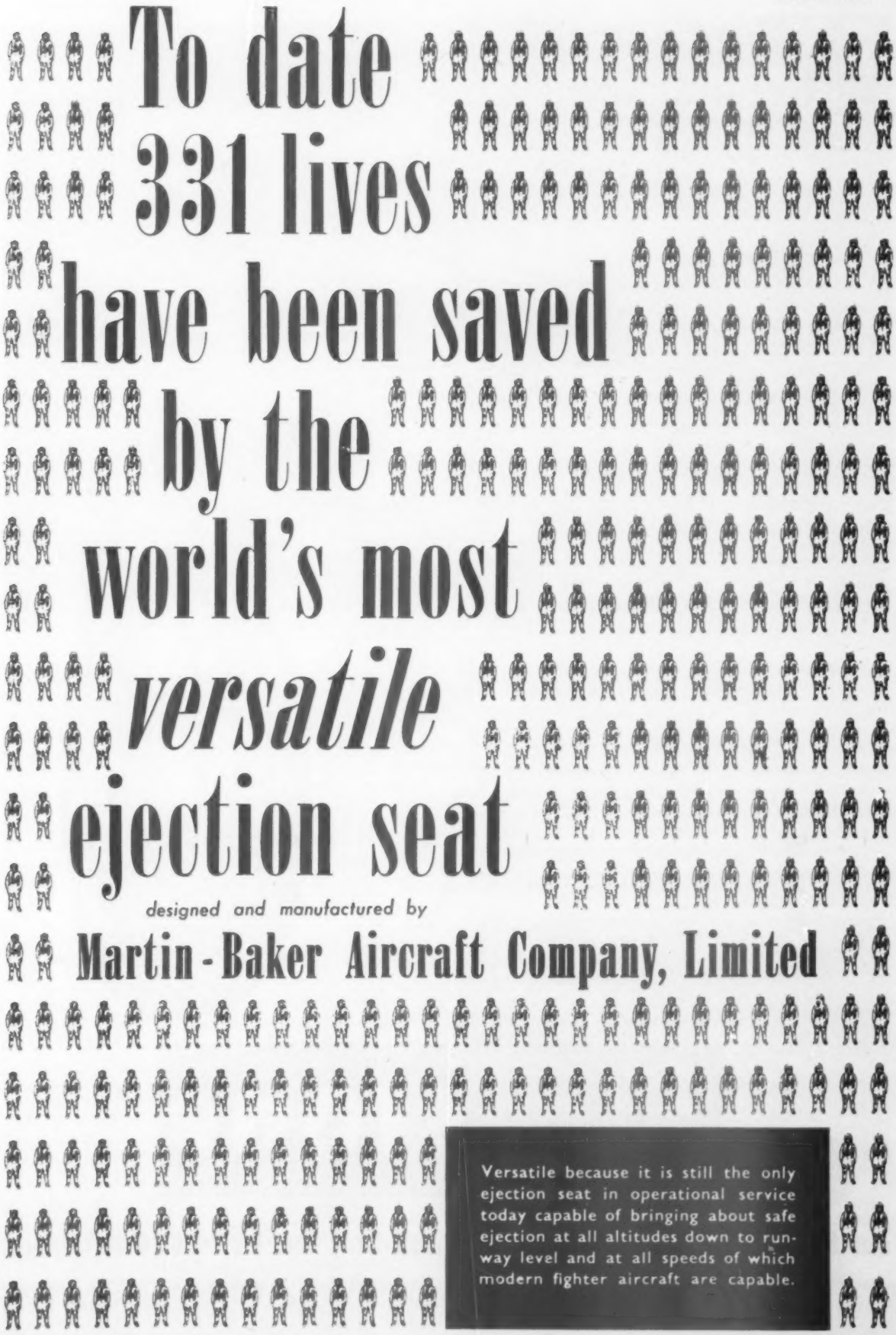

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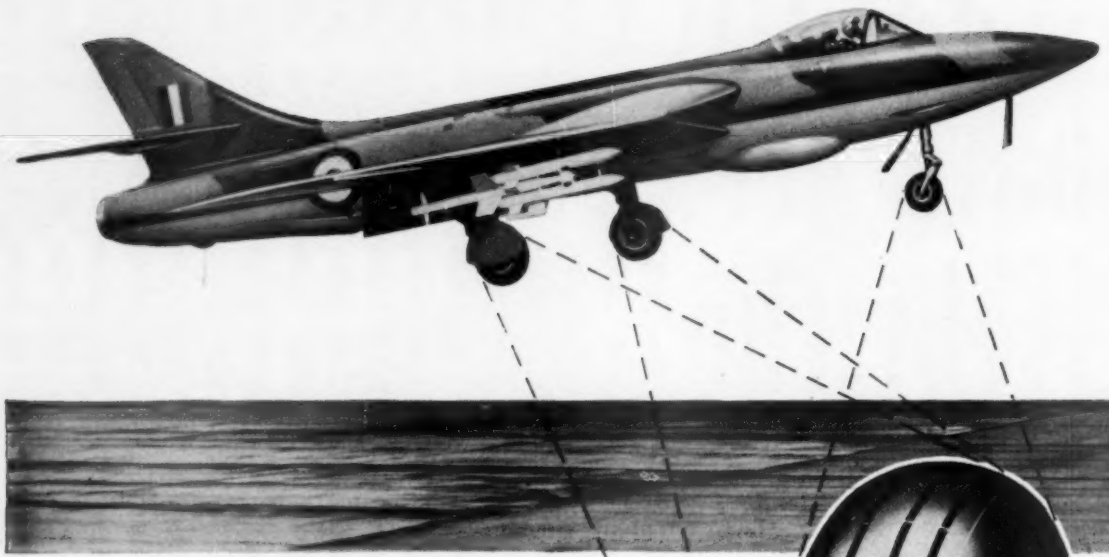

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Type illustrated measures 29.8" x 5.5" x 10.3"

IPN from fuel store (A) enters combustion chamber (B) is ignited by cordite charge (C).

At (D) hot gas joins atomised coolant. Most of resultant mixture goes to operate power supplies machinery, via supply line (E). Some, however, is tapped off through pipes (F) to drive pistons (G) which expel fuel and coolant, so making the system self-sustaining.

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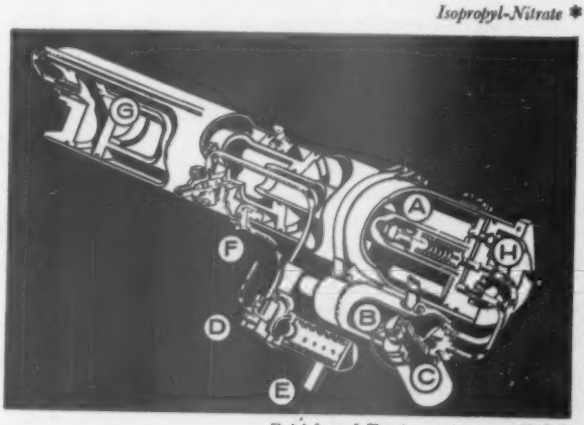

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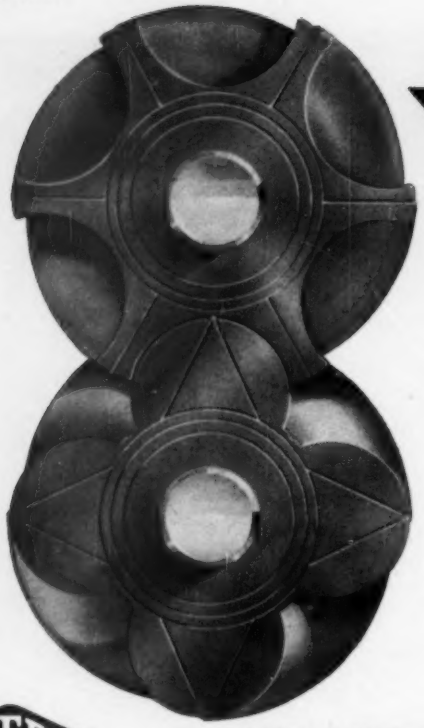

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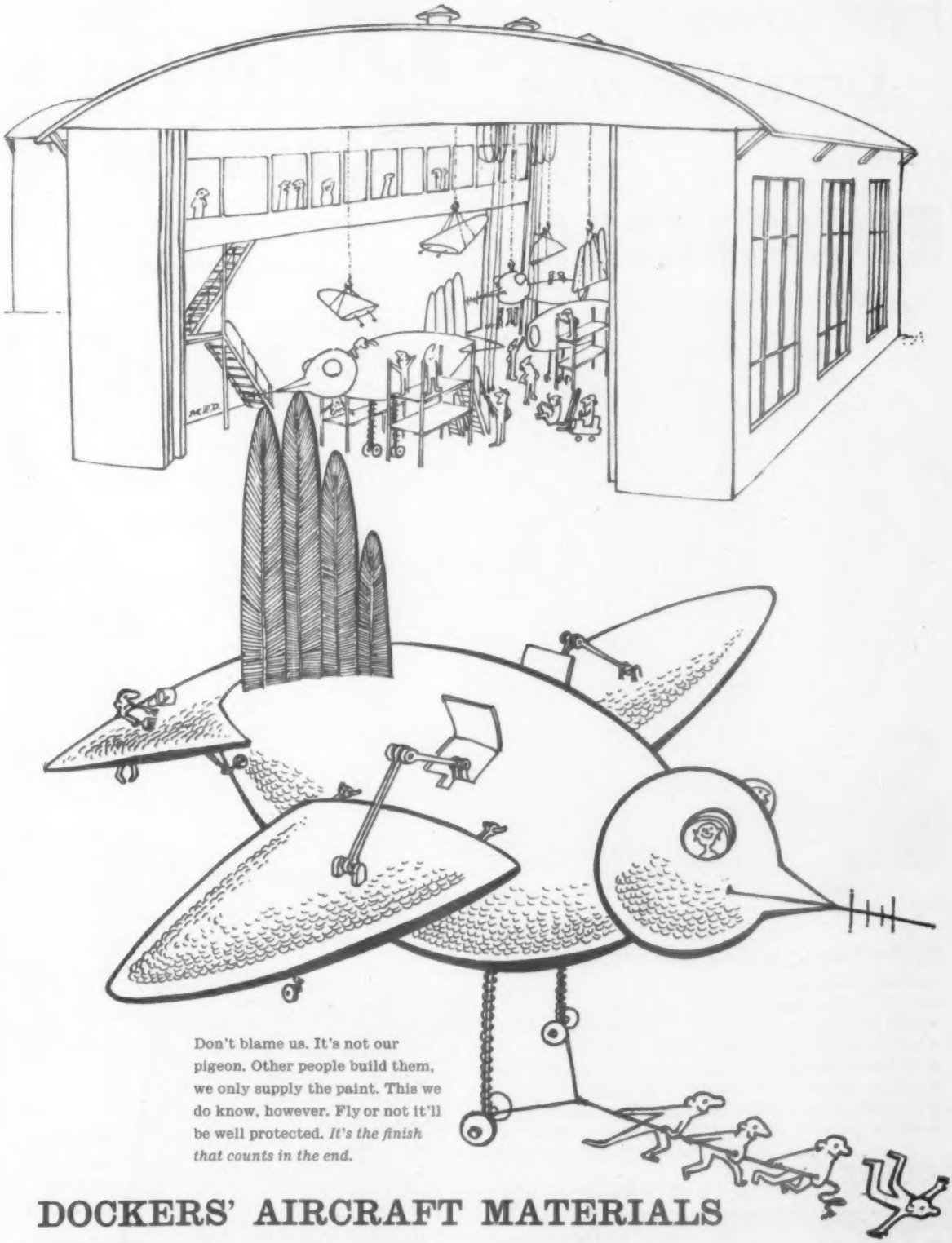

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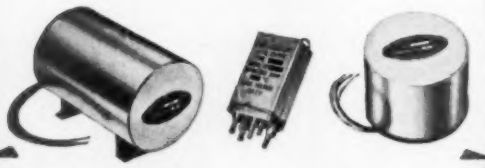

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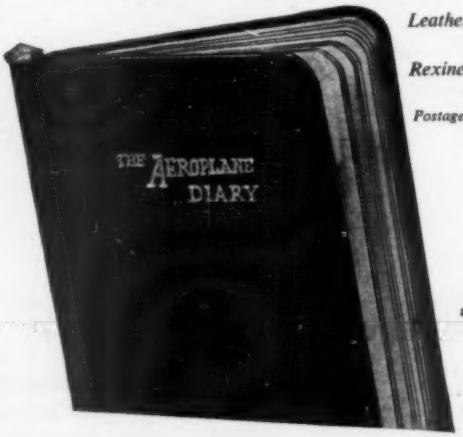

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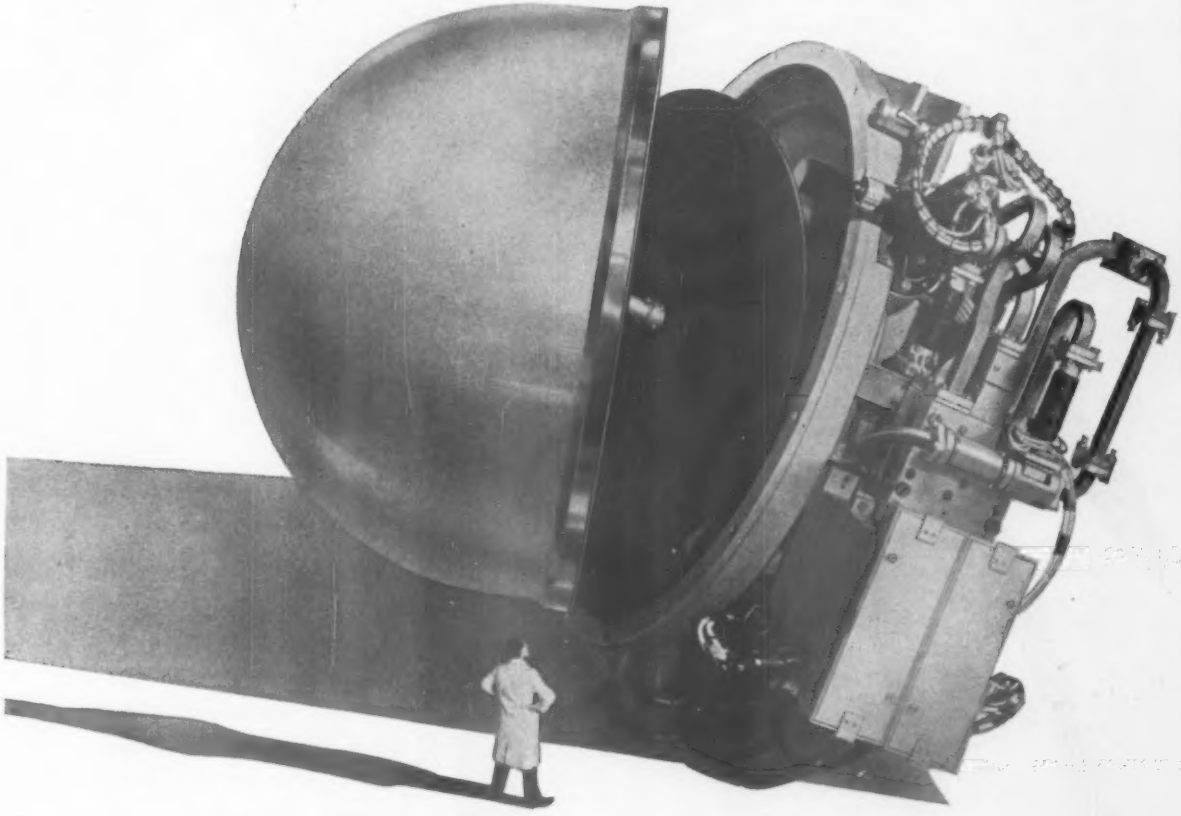

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THE AEROPLANE and ASTRONAUTICS

VOLUME 98 NUMBER 2526 MARCH 18, 1960

Two-purpose Deterrent

Thor is in the news. The last of the 60 American-built intermediate-range ballistic missiles to be deployed in this country was flown over last week, not without some ceremony. A much more impressive demonstration of Thor's capability took place when a button was pressed at Jodrell Bank. When the radar command had travelled 5,000 miles, the instrumented satellite-head went off on its 311 days' circuit of the Sun. As is explained in a special article in this issue, Thor was the booster or launching rocket; it required two more stages to put the 95-lb. sphere into orbit. However, the successful use of this comparatively short-range IRBM shows what could be done if our scientists were authorized to put their successful Black Knight on top of Blue Streak which has about twice the range of Thor. The latest thinking about this is also reported in this issue.

Of Thor the American technical Press states that it is the only Western long-range ballistic missile ready for combat. Behind it lies a record of 87 firings, a dozen of them by Service crews. Apparently, some months have yet to go by before the U.S.A.F. can regard two Atlas launching sites as operational.

It is, of course, only to be expected that the country which has had first-hand devastating experience of ballistic missiles (V-2) should be the first to deploy them. The irony lies in the fact that such a country should have had to obtain such vital weapons elsewhere.

Bleeding to Death

Why should the able chairman of the British Gliding Association, Mr. Philip Wills, speak of "a general feeling of indignant frustration" in his report at the annual general meeting of the British Gliding Association? His own career in this particularly individualistic branch of aviation has demonstrated a vigorous capacity to overcome frustration, as his notable international successes have shown. The progress of the Association itself may generally be conceded to have been steady if not spectacular. What, then, has brought about these public expressions of concern?

It has, as most people know, been an uphill fight to ensure that the gliding clubs shall be able to operate in reasonable conditions. The Government, it may be fairly said, have shown no signs of any positive policy for non-military flying other than aspects of mass transportation. It is equally true that the Services have shown only a limited interest in gliding. And of the three of them, the R.A.F. came to it last.

However, the real worry is that the British gliding movement is increasingly suffering from progressive anæmia. Its life blood is slowly draining away. The simile, bringing to mind a corpse-like figure bleeding to death in a bath, may be thought too violent. But to those who are aware of the facts, the outlook is indeed drear.

For many years, thanks to the generosity of Lord Kemsley, the aviation clubs have had a fund of £100,000 available for loans to buy new equipment, etc. Such loans were repaid out of earnings. And when repaid the capital became available to finance further purchases elsewhere. Now the fund is being wound up.

The B.G.A. want the Government to loan them money now that help is no longer coming from private benevolence. Life-giving ichor from the Government blood bank might be forthcoming if the Services were to be persuaded that to soar is in the National Interest.

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Matters of Moment

Money Wanted for Soaring

"THERE are still a great many people in the aircraft industry who believe in flying," said MR. E. C. BOWYER, Director of the Society of British Aircraft Constructors, as he presented the 1959 trophies at the Annual Ball of the British Gliding Association on March 11. (These were listed in THE AEROPLANE AND ASTRONAUTICS, p. 321, for the same date.) "But there will come a time," he added, "when the Air Ministry will be run entirely by people who have no interest in aviation as a sport." The S.B.A.C. always contributes handsomely to the expenses of sending a British team to the World Gliding Championships, and Mr. Bowyer, wishing this year's team the best of luck, said his Society was proud to be associated with them.

"A general feeling of indignant frustration" was expressed by MR. PHILIP WILLS, chairman, in his report to the annual general meeting of the B.G.A. on the following day. Mr. Bowyer, who had evidently been through the report beforehand, expressed every sympathy with this feeling in his speech at the Ball. Our difficulties, said Mr. Wills, are exactly what they were a year ago—even 10 years ago, "and our new Government has, at the time of writing, shown neither understanding of them nor any desire to help solve them." He compared our 41 civil gliding clubs with over 500 established in Germany since gliding began there again in 1951.

A severe blow is the ending of the Kemsley Flying Trust with the retirement of Lord Kemsley. Some £54,000 has been circulating among the gliding clubs—being alternately loaned and repaid out of revenue earned by equipment bought with the loans. But now, as the last repayments come in, they will be lost to the gliding movement. The Shaw-Slingsby Trust has had no time yet to build up such a trust fund, but is ideally placed to administer one established by the Government.

However, the demand for gliding experience is growing so fast, and the present number of gliding sites is so inadequate to cope with all who would like to fly from them, that a fund of £500,000 will be needed to cope with future expansion.

For the present, progress continues. Flying hours totalled 27,384 during 1959, compared with 21,536 in 1958; this does not include the Air Training Corps. Total launches in 1959 were 157,540, plus 102,434 by the A.T.C., adding up to 259,974 compared with 135,074 in 1958. Total flying membership of clubs went up from 4,015 to 4,286 during the year; the rise during the previous year had been over 1,000.

The "ten plus examination" was the main topic at the ensuing informal discussion. This is a scheme whereby all gliders over 10 years old must be comprehensively examined for airworthiness by a "senior inspector"—a post created for the purpose. Several people started off by complaining about the expense; but gradually, in the course of argument, considerations of safety wore down those of finance and the scheme was finally approved *nem con.*

The annual instructors' conference, which followed the general meeting, will be reported later in "Gliding Notes."

A.E.S.

Strategic Airlift in the U.S.

UNITED STATES strategic-airlift exercises make an interesting comparison with the relatively small ones staged by British forces. The latest U.S. exercise, Big Slam/Puerto Pine, began last Monday; it involves collecting 22,000 troops and 12,000 tons of equipment from various bases in the U.S., flying them to Puerto Rico (which is 1,740 miles from the nearest of these U.S. bases) and then returning the troops and equipment to their U.S. bases.

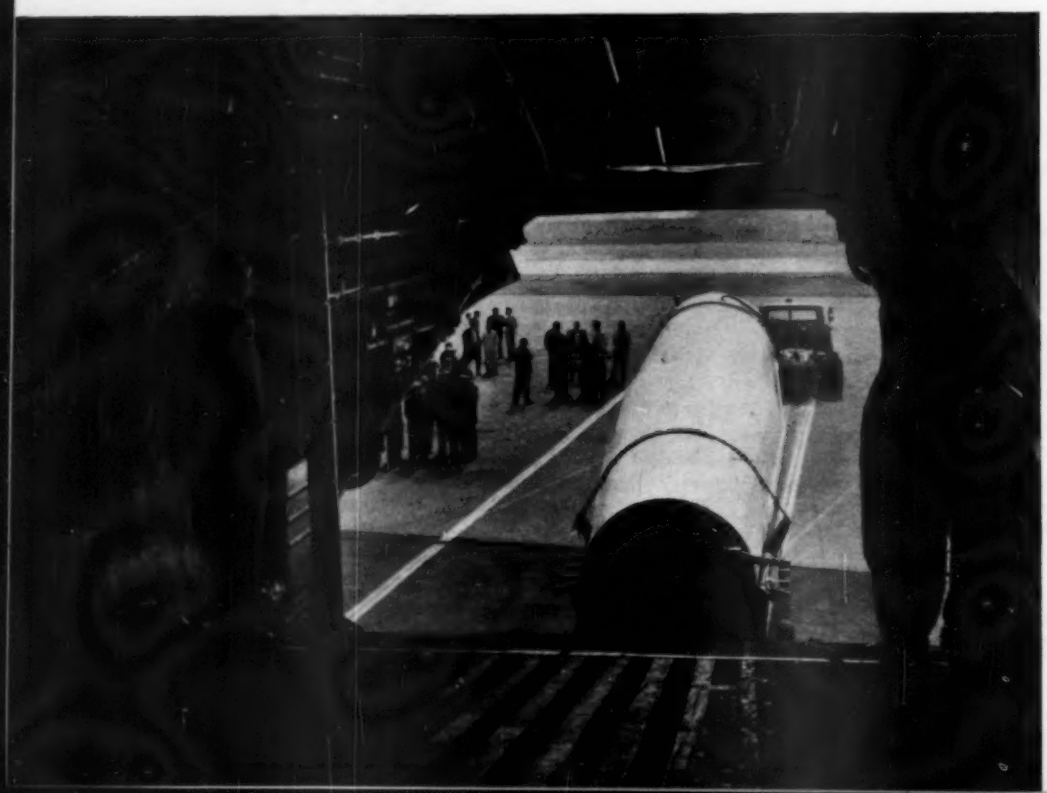
The whole operation will take 14 days. It is regarded primarily as an exercise for the U.S. strategic airlift force, the Military Air Transport Service (MATS), and for the troops of the Strategic Army Command (STRAC). And, incidentally, it may also give Fidel Castro of Cuba food for thought.

To meet this commitment, the utilization rate of the MATS fleet must surge from its normal peacetime level of five hours a day to eight hours a day. Routine MATS services throughout the World will be maintained and during this fortnight 46,000 flying hours will be logged by nearly 450 aircraft of the MATS fleet; about 220 of these will be taking part in BS/PP.

Although this exercise indicates the capabilities of MATS, this U.S. command is worried about its future ability to meet emergency or wartime demands which may be made on it. MATS is making increasing use of commercial carriers; in 1955 airlines were paid $4.5 million for overseas airlift services, and this figure rose to $71 million in the fiscal year 1959.

MATS is worried about the approaching obsolescence of its airlift fleet; most of its 485 aircraft are about 10 years old. Its newest cargo aircraft is the turboprop Douglas C-133—roughly equivalent to the Short Britannic which is scheduled for R.A.F. service in several years' time—but MATS urgently needs a turbojet cargo transport which could keep pace with and lend support to the bomber force of Strategic Air Command. A workhorse aircraft is also needed to replace the ageing C-124 Globemasters which form the bulk of the MATS fleet.

The feeling in the Service is not disguised that continuing dependence on outmoded aircraft represents a serious weakness in the strategic airlift ability of the U.S.A.F. As reported elsewhere, dissatisfaction with the strength of R.A.F. Transport Command was expressed in the Lords last week.



DELIVERY COMPLETED.—The sixtieth Douglas Thor IRBM for the R.A.F. was delivered to North Luffenham last week; an account of the delivery and more about the missile is on pages 343 to 345. Thor was also in the news last week as the first stage of the boost system which has put Pioneer V on course around the Sun (page 331).

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COMBINED OPERATORS.—The latest unit to go into service with the Royal Navy, H.M.S. "Bulwark"—the commando carrier—has now joined the Fleet and is on her way to the Far East, via the Mediterranean.

To Encourage Ownership

AT long last stereotyped air races are to give way to competitions with a definite plan behind them to encourage ownership and operation. It is also hoped to improve the breed. The Royal Aero Club has announced its decision to organize a competition to this end.

This competition is to take place on May 20 and 21 at Shoreham. Friday, May 20, will be taken up by a formula event over about 400 miles. The formula will be based on seat-miles per gallon and elapsed time.

Saturday, May 21, will be devoted to various tests and checks at Shoreham, including Short Take-off and Landing (STOL), taxi-ing, manœuvrability, comfort, equipment and the like.

The aircraft will be divided into three classes:—

Class I—Single-engined aircraft with up to two seats and an all-up weight not exceeding 2,200 lb.

Class II—Single-engined aircraft with more than two seats or an all-up weight of more than 2,200 lb. but not exceeding 12,500 lb.

Class III—Twin-engined aircraft with an all-up weight not exceeding 12,500 lb.

Prize money will be the same for all three classes: 1st £100; 2nd £75; 3rd £50; 4th £25; and the Osram Cup will be awarded to the overall winner.

The fact that for aircraft registered before January 1, 1950, there will be additional premiums of £50 (1st) £25 (2nd) seems to indicate that the English veneration for the antique is still to be encouraged. Why not a prize for the most sophisticated entry?

Progress With the Cushioncraft

A LITTLE more information came to light last week concerning the Cushioncraft being built by the Britten-Norman company at Bembridge, Isle of Wight. Readers will recall that last year it was disclosed (THE AEROPLANE AND ASTRONAUTICS for October 16, 1959) that this private-venture project was smaller than the Saunders-Roe Hovercraft.

While making use of the general curtain-lift principle, the Britten-Norman craft, however, was said to produce its air cushion by a different method from that used in the SRN-1. It would generate a slightly higher air-pressure and have a correspondingly greater hovering height. The Cushioncraft was to be powered by an "automotive-type" engine and a pair of variable-pitch airscrews would provide propulsive thrust and differential control forces.

It has now been reported that these airscrews are, in fact, helicopter tail rotors and that the powerplant will be a well-known racing car engine. However, perhaps the most interesting of the recent disclosures is that a share of the development cost of the project is being taken by Elders and Fyffes the fruit growers and importers. This company has a particular interest in transport problems in out of the way places and quite clearly a craft of this type, capable of operating away from carefully prepared land surfaces—and over water if required—would solve many of their problems.

Indeed, it has been said that as a means of transport in the sort of areas in which Elders and Fyffes, for example, are interested, a Cushioncraft capable of carrying a 15-ton payload would prove an economic proposition. No roads would need to be built—throughways bulldozed through the plantation would suffice—and the rivers could be traversed in the dry season when they are usually unusable by conventional lighters.

To date, about 7,000 man-hours have been spent on the Cushioncraft prototype at Bembridge and by the time it is finished, it has been said, somewhere around £10,000 will have been spent on it. No details are yet available of its performance and structural and technical features.

Self-help in South Africa

A NEWCOMER to the lightplane market is to be produced by South Africa's only aircraft factory, General Aircraft (Pty.), Ltd. Launched officially at a ceremony in Durban on Feb. 20, the new machine, known as the Aeriel, is the company's first product. It is a two-seater with a range of 750 miles powered by a Continental 90 h.p. model. It sells in Durban for just under £2,000.

The company believes that a valuable market for light aircraft can be developed in South Africa and it is now planning to turn out two Aeriels a month, mainly for export in the first few months of operation, as the local market has still to be developed to the pitch to justify output on this level.

Matters of Moment . . . .

An Order for Argosies

TRANS-ARABIA AIRWAYS has placed an order for two Armstrong Whitworth Argosies, for delivery in the middle of this year, and has taken an option on a third. The contract is worth about £1,100,000, including spares. Trans-Arabia Airways, which has been interested in the Argosy for two years, will become the first airline in the World to operate this Dart-engined freighter/passenger airliner.

With its headquarters in Kuwait, Trans-Arabia Airways operates scheduled services over a network of routes in the Middle East. It has been flying two DC-4s and is now introducing two DC-6s for the coming summer season.

More news of the Argosy appears on page 333.

Air Defence in the Lords

WHEN the Lords turned their attention to defence last week the debate reflected the current dilemma of the fixed base or the mobile base.

It also brought from Lord Hailsham a staunch passage about the importance of the V-bombers to Western defence, spoken in terms rarely used by the phlegmatic British, and a passage on conventionality of arms which raised some eyebrows, writes "PARLIAMENTARIAN."

Lord Hailsham declared that for quite a long time to come the purely British component of the West's deterrent was going to be not merely an important, but possibly an indispensable part. "I believe," he said, "that if either the British or the American public realized the extent to which as of now the Allied deterrent depends on the British V-bomber force, there would be less loose talk about sending us out of business and less nonsense talked about our not being able to afford our subscription to the so-called 'nuclear club.'"

Lord Alexander of Hillsborough, an hour later, interpreted some of Lord Hailsham's words as meaning that the Government "are doing their level best to get away from the effects of the policy introduced by Mr. Sandys in 1957."

You could, perhaps, deduce further along these lines from Lord Hailsham's remarks about conventionality. The fact was, he said, that our Forces were now, and would remain in future, overwhelmingly "conventional" in character. This, coming on top of remarks to the same effect in the White Paper, seemed to tell a story. Lord Hailsham made the point that if one side had virtually nothing but long-range nuclear weapons, a surprise attack by the other with highly mobile conventional forces could present the wholly nuclear power with a *fait accompli*.

Aviation in Parliament

ARE there indeed too many Air Commodores and above in the R.A.F.?

The question was raised in the committee stage of the Air Estimates, by MR. GEOFFREY DE FREITAS (Lab., Lincoln) the Opposition's Shadow Air Minister. There were, he said, still 240 in the R.A.F. of the rank of Air Commodore and above. The Service looked like becoming top-heavy—and SIR ARTHUR HARVEY (Cons., Macclesfield), an Air Commodore himself, agreed. The Service was being reduced all round, but they still had the same number of Air officers.

But Mr. Taylor, the Under Secretary, did not think the number was unreasonable for carrying out the R.A.F.'s commitments, both national and international.

The Army Estimates brought out mobility and the need for it again—this time in relation to troops instead of rocket bases. But MR. STRACHEY (Lab., Dundee W.) commented that in spite of this, there was still no date for the Britannic.

When will London Airport be saturated? Mr. Sandys thinks it unlikely that, with Gatwick in full use, this point will arrive in less than six or seven years.

Meanwhile, additional passenger accommodation and aircraft stands are being provided. More are being planned in line with the Millbourn Committee's recommendations in 1957.

As for dilapidations, he told Sir Arthur Harvey that a new long-haul passenger building to replace the existing temporary buildings along the Bath Road is already under construction in the central terminal area, and a good deal of repainting and redecorating is being done, which should be complete in the near future.

Mr. Marples, the Minister of Transport, was asked if he would consider giving the Transport Commission power to develop inter-city helicopter services, but he replied evasively that he "knew of" no such proposals. When he was pressed to say if he was interested, or if he was "going to leave it to private developers to introduce this kind of travel," he replied merely that he thought the Commission had a lot of work to do in the near future. But this was a reference to railways.

He was asked to bring in legislation to give him powers to establish helicopter rescue services in all parts of the coast where they might be needed. The questioner suggested that this was necessary "in view of the current withdrawal of R.A.F. and Navy helicopters" from rescue work. But Mr. Marples replied that there had been no withdrawal and there is a full coverage of the coasts.

The Aerodrome Owners Association and the Association of Municipal Corporations have had talks with Mr. Sandys on the development of airports for large cities. They have undertaken to put detailed proposals to him. "PARLIAMENTARIAN."

More From the Olympus

THRUST from the Bristol Siddeley Olympus turbojet continues to be increased. News was released last week of the latest version—designated Olympus 21—which develops a static thrust of 20,000 lb. without reheat. This, it is claimed, makes it the most powerful British military aero-engine to date.

Developed from the earlier 17,000-lb. Olympus 201, this new version has an extra stage at the front of the low-pressure compressor and a larger air intake. It is intended for later versions of the Vulcan V-bomber; but, no doubt, it can also be regarded as a development step towards the special Olympus powerplant that Bristol Siddeley are producing for the Vickers/English Electric TSR-2.

No performance details of the Olympus 21 are available except for the quoted thrust. Its overall length is given as 156 in. and the intake diameter as 42 in.

Safety in the U.S.A.F.

THREE months ago the U.S.A.F. had its first missile fatality—a man fell off a truck towing a missile. This was stated in London earlier this week by Maj.-Gen. Joseph D. Caldara, the U.S.A.F. Deputy Inspector-General for Safety, who discussed U.S.A.F. accident rates and accident-prevention philosophy. General Caldara, whose office is responsible for flight, missile, nuclear and ground safety, has been visiting U.S.A.F. establishments in Europe and Britain.

Flying safety in the U.S.A.F. has increased considerably since 1950, despite the introduction of high-performance aircraft. In 1950 there were 36 major accidents per 100,000 flying hours; in 1959 this figure came down to 8.3 major accidents per 100,000 hr. In 1950, 14 aircraft were destroyed per 100,000 flying hours; the comparable figure for 1959 was less than 6. In 1950 there was a pilot fatality every 16,000 flying hours; in 1959 this had improved to an all-time record of 42,000 hr. per pilot fatality.

In 1954 more than 450 people were killed, and there were more than 1,600 major accidents with more than 600 aircraft being destroyed. In 1959 less than 150 people were killed and there were under 800 major accidents and less than 200 aircraft destroyed. But, because of the higher performance of aircraft, 29% of the pilots who had major accidents were killed, compared with 17% in 1954.

Asked about the safety record of the Lockheed F-104, Gen. Caldara said that it was very good allowing for the fact that this was a "breakthrough" aircraft. Its accident record was better than that of World War II piston-engined fighters; for every F-104 squadron that had had an accident there were two free of major accidents.

Other points made by the General were that, in his view, current flight-instrument presentation was out of date; that VOR was limited by insufficiency of channels and that a visual navigation presentation was needed; that current altimeters were not sufficiently accurate; that there were twice as many undershoot accidents on landing as overshoots; that "if you're going to fly jets, you need to fly them often."

Sir Frederick Bowhill

IT is with great regret that we record the death, on Mar. 12, of Air Chief Marshal Sir Frederick Bowhill, G.B.E., K.C.B., C.M.G., D.S.O. and Bar. An outstanding personality, Sir Frederick had a most distinguished Service career and will long be remembered for the contribution he made during the War—first as Commander-in-Chief of Coastal Command; later as A.O.C.-in-C. of Ferry Command, the transatlantic bomber-ferry service; and afterwards as A.O.C.-in-C., Transport Command. Sir Frederick Bowhill retired from the R.A.F. in 1945 and subsequently became chief aeronautical adviser to the Ministry of Civil Aviation (later M.T.C.A.), a post he held until his death.

Getting Pioneer V Round the Sun

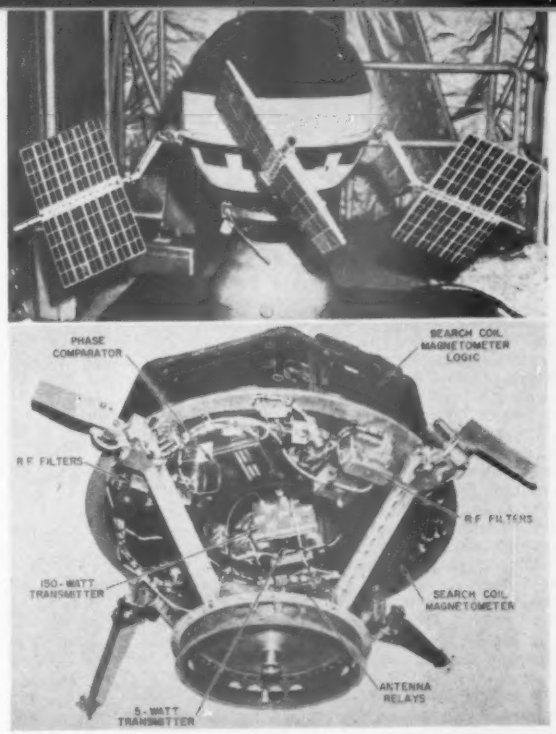
PIONEER V's epic journey around the Sun not only represents a technical triumph for the United States but it also further underlines the value of the Jodrell Bank Experimental Station in space-research. It was a signal transmitted from the 250-ft. radio-telescope, some 25 minutes after the Thor-Able 3-stage rocket had left the launching pad at Cape Canaveral on March 11, that effected separation of the 95-lb. probe from the final stage carrier rocket.

Subsequently, Jodrell Bank has been the means of switching on and off the probe's 5-watt 378-Mc/s. transmitter, and the British equipment will continue to be used for tracking and communication purposes until Pioneer V goes out of radio-range in July at a distance of about 50 million miles. (It is hoped to switch on a higher-power 150-watt transmitter when the vehicle is a million miles from Earth.) It will then probably be three years before Earth and probe, in their respective orbits around the Sun, once again come within signalling distance.

Four paddle-like vanes extend from the probe's 26-in.-dia. spherical centre-body and contain solar cells. These generate electricity directly from sunlight to recharge chemical batteries. It will be a severe test of the space-borne electronics and power supplies if, after three years, the transmitter is still in working order and can be switched on from Earth. A danger is that the probe may suffer meteorite damage during its extensive travelling.

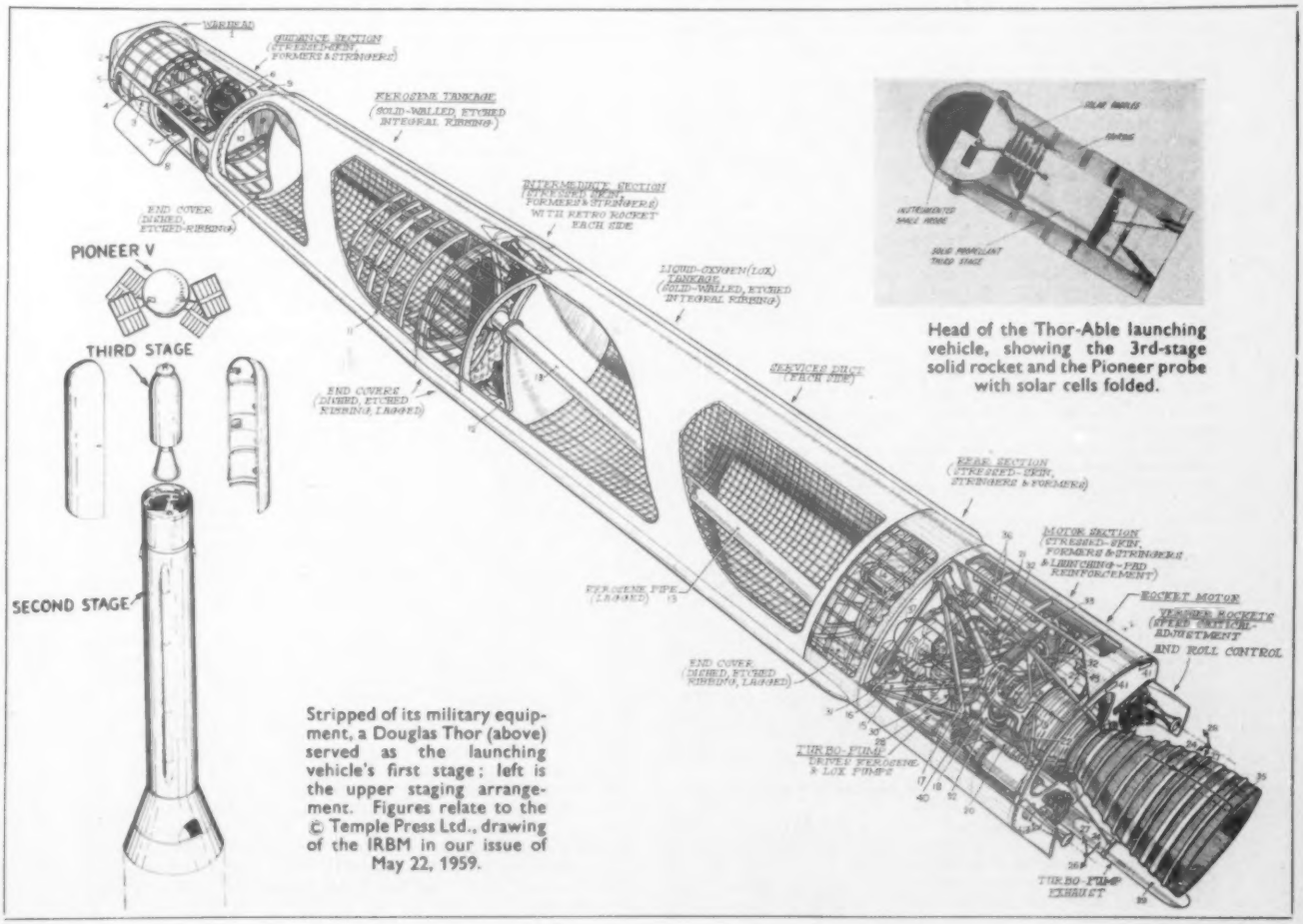
Despite a successful launching, it was not entirely in accord with prediction. The probe was intended to go into an elliptical orbit which just crossed the orbit of Venus, but in fact its projection velocity was about 150 m.p.h. short of the desired figure of about 25,020 m.p.h. This means that instead of taking 295 days to make one full circuit of the Sun, it will now take about 311 days, and it will remain outside the orbit of Earth and inside that of Venus. Its closest approach to the Sun will be approximately 74,700,000 miles. (The mean distance of the Earth from the Sun is 93 million miles.)

Instruments carried in Pioneer V include a high energy radiation counter and an ionization chamber and Geiger-Müller tubes to measure medium-energy radiation. There is also a magnetometer for determining the strength and direction of magnetic fields in space; a micro-meteorite detector, and an aspect indicator which triggers an electric impulse when it faces the Sun.



Pioneer V—external and internal details.

Head of the Thor-Able launching vehicle, showing the 3rd-stage solid rocket and the Pioneer probe with solar cells folded.


PIONEER V
THIRD STAGE
SECOND STAGE
END COVER (DISHED, ETCHED-RIBBING)
KEROSENE TANK(AB) (SOLID-WALLED, ETCHED INTEGRAL RIBBING)
INTERMEDIATE SECTION (STRESSED-SKIN FORMERS & STIFFENERS) WITH RETRO ROCKET EACH SIDE
LIQUID-OXYGEN(LOX) TANK(AB) (SOLID-WALLED, ETCHED INTEGRAL RIBBING)
SERVICED SKIN (EACH SIDE)
END COVERS (DISHED, ETCHED RIBBING, LAGGED)
KERO. SECTION (STRESSED-SKIN, STIFFENERS & FORMERS)
MOTOR SECTION (STRESSED-SKIN, FORMERS & STIFFENERS & LIGHTENING-PAD REINFORCEMENT)
KEROSENE PIPE (LAGGED)
ROCKET MOTOR
VERNIER ROCKETS (PITCH, ROLL & YAW ADJUSTMENT AND ROLL CONTROL
END COVER (DISHED, ETCHED RIBBING, LAGGED)
TURBO-PUMP (DRIVES KEROSENE & LOX PUMPS
TURBO-PUMP EXHAUST

Stripped of its military equipment, a Douglas Thor (above) served as the launching vehicle's first stage; left is the upper staging arrangement. Figures relate to the © Temple Press Ltd., drawing of the IRBM in our issue of May 22, 1959.

Filton's Great Engine Contribution

SINCE he is president of the Bristol Branch of the Royal Aeronautical Society it must have pleased Professor Collar a great deal to see such a distinguished company gathered to hear Sir Roy Fedden deliver the seventh Barnwell Memorial Lecture. His subject was the first 25 years of the Bristol Engine Department which came into existence shortly after the end of World War I.

The achievements of aircraft built in that period and powered with Bristol engines played a considerable part in the lecture and as illustrations on the screen. And in the audience were those who had played their parts in developing the engines, at Bristols and at the Air Ministry, and in flying them. In the audience was Lord Sempill who was among the few fortunates who actually flew in the Dornier Do.X with Siemens Jupiter engines.

In paying tribute to Frank Barnwell the lecturer disclosed that he first met him in 1917 when the famous designer was instrumental in arranging for the young Fedden to have his first flight. This was not unnaturally in the Bristol Fighter, the Rolls-Royce Falcon engine of which had been built by Strakers, the firm with which the young Fedden was working.

It was some three years later than this, in July 1920, that the acquisition by the Bristol Company of the Cosmos aero-engine business and the design and engineering team under Roy Fedden was announced. And the business was bought for £15,000. At the end of his lecture Sir Roy gave a figure of 142,000 engines as the grand total of Bristol engines produced over the period of the review.

This lecture of Sir Roy Fedden should be studied and debated. Contained in it are lessons painfully and expensively learnt which all too soon are taken for granted in the contemporary engineering régime and then forgotten. But inexorably they will appear again and the whole cycle will take place once more. Perhaps somebody will think it worth while to give an annual prize for a paper submitted, by an apprentice, on some aspect of Sir Roy's paper. As Sir Reginald Verdon Smith said in his address of thanks to the lecturer, his paper had kindled the enthusiasm of all who heard it.

Perhaps these things are clearer to see if one has lived through the period under review, but to one member of the audience in the Main Lecture Hall of the University of Bristol it was vividly apparent that the occasion provided plenty of material by which to measure the present conditions of British aviation.

Another thought came to mind as the lecturer recalled achievements and illustrated historic aeroplanes on the screen. It was the remarkable part that the scrupulously engineered products from Filton played in building up aviation in Europe. How many people today have any idea that the first remarkable achievement of the young Willy Messerschmitt was made possible by the Bristol Cherub engine which carried his two-seater M.17 over the Alps at 14,750 ft. on its 375-mile trip from Munich to Rome in 1928.

It is true that W. S. Shackleton, also present at the lecture, had carried off the Air Council prize of £3,000 at Lympne in 1924 with the same engine which he had used to power a two-seater monoplane. However, not only the Cherub but, more important, the Jupiter won golden opinions overseas. So much so that in the late 'twenties the French Press were upset because nearly 80% of the aircraft at one Paris Aero Show had Jupiter engines, a number made under licence.

Working with our Neighbours

During the first 10 years of the Engine Department, Bristol radial air-cooled engines were installed in 262 different prototype aircraft throughout the World and over 70 of them went into series production. This is an illustration for those who wish to see it of the part that engineering talent in this country should be playing on an ever-increasing scale in European collaboration. It is of course fairly widely realized how big a part British aero-engines play in aeronautical affairs today. But this collaboration with European manufacturers, in which Bristol products were so conspicuously successful between the Wars, needs to be developed in a wider range of activity today.

The second decade of Bristol engine development began in 1930 and by 1935 the 4-valve, 9-cylinder, 5¼-in. bore family of radial engines had reached its zenith. The lecturer gave some time to telling his audience about the development of the sleeve-valve engine. As he recorded in the first part of his paper, he had first been interested in the possibilities of the sleeve-valve when he saw the Argyll Burt-McCollum single-sleeve-valve engine win the 1914 Naval and Military aero-engine trials.

It was about the autumn of 1927 that work started at Filton. Major G. P. Bulman was present at the lecture to hear the tribute paid to his encouragement in those early days. Finally, after many thousands of hours on single-sleeve-valve engines, a complete engine was got to run. It could pull excellent power with good fuel consumption, but the only way the oil consumption could be stabilized was to squeeze every sleeve round after hardening, and then grind each piston and cylinder to fit the particular sleeve.

The National Airline's Part

The part that a national airline can play in developing the product is to be found exemplified in the fact that Major Woods-Humphery, general manager of Imperial Airways, Ltd., tested about a dozen of these hand-made sleeve-valve engines (called the Perseus) with remarkably good results. This type of collaboration is seen today in the success of the Viscount resulting from the collaboration of B.E.A. and Vickers. Much more will be needed if we are to make successes of the VC 10 and the D.H.121, and behind them looms the shadow of the supersonic airliner.

The development of the sleeve-valve was undoubtedly the longest and most serious battle of his career at Filton. Sir Roy Fedden believes that the Bristol Company and the Air Ministry spent over £2 million between them solely on developing and getting the sleeve right for production.

Between 1936 and 1938 over 3,000 flight testing hours were flown on three different aircraft. By 1937 the first Hercules type of double-row sleeve-valve went into production. By early May, 1938, the drawings had been cleared for the Centaurus. The first engine was running by the middle of July, 1939, and the first type test was completed in April, 1940.

By the time the Second World War broke out, the total number of Bristol engines manufactured over the second decade of the Bristol Engine Department by the parent company and its licensees amounted to 18,570. This output, although considerable, and again by far the largest from any designer in Europe, was just surpassed in the United States.

Much interest in the paper lies in Sir Roy's frank appraisal of war-time problems. Of the gas turbine he notes that he has understandably come in for a good deal of criticism for being slow in taking up such engines on behalf of Bristol. Immediately after the War this worried him a great deal, but in mature retrospect he is convinced that if he were to be faced with making the decision again, he would make no change. If the Bristol Engine Department had attempted to go over to the jet engine with this new sleeve-valve family of engines still on their hands, he thinks it would have been disastrous.

He goes on to discuss the potentialities of the higher-powered, double-row, sleeve-valve family of engines which were never produced, but which he believed should have powered the first post-War generation of civil aircraft.

At the outbreak of war, Bristol engines powered 52% of R.A.F. aircraft, but from about 1938 Sir Roy remarked that some setbacks had been suffered as regards selection of Bristol products for new prototype aircraft. It was some time before the merits of the Centaurus were appreciated, but eventually it went into production in the Blackburn Firebrand, the Bristol Buckingham and Brigand, the Vickers Warwick, Hawker Tempest II and Hawker Sea Fury, which Sir Roy says ended up as the fastest fighter (propeller-driven) of the War period. It was outside the time scale of the lecture, but it was worth recalling that this extremely clean aeroplane put up a remarkable performance in Korea.

The most important British Service aircraft employing Bristol engines during World War II were the Hampden, Gladiator, Blenheim, Beaufort, Wellington, Beaufighter, Stirling, Sunderland, Swordfish, Lysander, Halifax and Tempest II. During that period the Bristol Engine Department, in collaboration with the shadow factories, produced the equivalent of 116,200 engines. The department, founded in August, 1920, with 31 people, had grown to about 20,000. Another 51,850 were employed by the shadow factories.

Finally, Sir Roy lays down in his conclusions the lessons which he considers should be drawn from the experience, so remarkably and readably set out in his lecture. In view of the importance which must be attached to the training of the rising generation we must hope that these conclusions will be studied and debated.

Air Transport

Middle East Comets

MIDDLE EAST AIRLINES has ordered four de Havilland Comet 4Cs, and has taken an option on a fifth. Announcing this last week, Sheikh Najib Alamuddin, M.E.A. chairman, explained that the order was an outcome of the new agreement signed between M.E.A. and B.O.A.C. on November 20 last year, following the disagreement between the two companies which had come to a head in September. The background to this situation was discussed in our issue for October 2, when we explained the interdependence of M.E.A. and B.O.A.C. and noted that the question of re-equipment was one of the most pressing problems.

The November agreement is in the form of a long-term charter, setting out the respective responsibilities of the two airlines and specifying the financial assistance to be given by B.O.A.C.

The re-equipment problem for M.E.A. revolved around the need to have jet transports by 1961 in order to remain competitive. This in turn called for an early start to be made on the conversion of 15 crews now flying Viscounts—without interrupting the Viscount operations. A study of all available types of aircraft narrowed the choice down to the Convair 880, Caravelle and Comet—and from this trio the Comet was chosen unanimously by the boards of M.E.A., B.O.A.C. Associated Companies and B.O.A.C.

The terms of the contract negotiated with D.H. called upon B.O.A.C. to guarantee the M.E.A. repayments on the loan, arranged through British banks. This particular clause was very nearly the cause of the whole deal being cancelled last week, for it required Treasury sanction, and this in turn led to a delay of unacceptable duration to Sheikh Alamuddin. The contract with D.H. had been signed on January 26, on the understanding that the B.O.A.C. guarantee would be produced within four weeks. When this time limit expired on February 23 the Treasury had not agreed to the deal, although it had been closely studied and gained the support of the boards of B.O.A.C. Associated Companies and B.O.A.C., and the Ministry of Aviation. A two-week extension was agreed, but this also expired, on March 8, without result, and next day the Sheikh told a Press conference that he was prepared to wait only seven more days. At the time of going to press, 24 hours before this limit expired, a verbal assurance had been given by the M.o.A. that agreement would be given, but the formal documents had not been signed.

Whether or not the Treasury approval, when it was eventually obtained, was unnecessarily tardy is difficult for the outsider to say, although once the blessing of the M.o.A. had been obtained it should have been an easy enough matter to decide—especially as B.O.A.C. are to receive the Comets in the unlikely event of M.E.A. defaulting in the repayments. The interesting point in all this was the position taken up by Sheikh Alamuddin who was, it seemed, prepared to sever connection with B.O.A.C. and enter into an agreement with another airline (Sabena? T.W.A.?) in order to obtain early deliveries of Caravelles or Convair 880s.

Delivery of the first M.E.A. Comet, which will have a cockpit and cabin standardized with the B.O.A.C. version, is scheduled for mid-December, and services will begin in April, 1961. The Comets are to be used to develop feeder services to the B.O.A.C. Comet network—to the Iberian peninsular for connections with the South American service; to Benghazi for South Africa; and to Tripoli for West Africa. There will also be three services a week between Frankfurt and Beirut, giving, with the B.O.A.C. flights, a daily service on this route, and a service from the important oilfield centre of Dhahran to connect with B.O.A.C. North Atlantic flights out of London.

The value of the initial order for four Comets is £5½ million. To de Havilland, however, the order may be of much greater consequence in leading to other Comet sales in the area. Sheikh Alamuddin forecast last week that there is a market for at least 30 medium-haul jets in the Middle East, including three Comets ordered by Misrair and the five for M.E.A. Other airlines likely to follow M.E.A. in buying Comets are Iraqi Airways, Iranian Airways, Saudi Arabian Airlines, T.H.Y. and perhaps a group of smaller operators in and around Kuwait. Air Liban, associated with Air France, is expected to order three Caravelles.

Power in Reserve

THE incident at Kastrup Airport, Copenhagen, a month or so ago—when three engines of a B.E.A. Comet 4B were damaged by grit and slush during a training/proving flight take-off—give rise to two obvious comments. One is that the incident might have been a good deal more serious with a less amply powered turbojet transport; the other is that aeroplanes are always liable to unforeseen new troubles even when they appear to have been well bedded-down in service.

Two engines on the 4B roughed up after take-off and were cut by the captain; a third was affected soon afterwards and was also cut. After flying on a single engine for a while one of the three engines was re-lit for an approach and landing back at Kastrup. The high power-weight-ratio of the Comet was advantageous not only in the airborne situation but in the way in which the aircraft accelerated successfully along a runway on which thawing snow would obviously have been offering more drag than expected.

One probable reason for the fact that this trouble has been encountered with the 4B—and not seriously by B.O.A.C.'s Comet 4s—is that it has a longer fuselage and that the nosewheel bow-wave spreads more widely, entering the outer as well as the inner intakes. The damage in this case was apparently caused by the grit in the slush rather than by the mass of thawing snow itself. Before the next winter season means will have been found of dealing with this hazard—by the use of a revised tread-pattern (now being tested at Hatfield) for the nosewheel, and/or of deflector plates.

Argosy Prospects

ARMSTRONG WHITWORTH AIRCRAFT has suggested to B.E.A. that it should hire a small number of Argosy freighters. The proposal is now being examined and there seems to be a good chance that B.E.A. will undertake to operate three Argosies in this way. Despite its rapidly growing freight traffic (see our previous issue, pp. 308-9), B.E.A. requires comparatively few aircraft to be engaged full-time on freight services, and has the additional complication at present of the introduction of Comets, Vanguards and, next year, Heralds. However, there is no doubt that the prestige value of Argosy operation by B.E.A. would be of great help to Armstrong Whitworth.

Many prospective overseas customers consider the backing of one of the two British airline Corporations to be most important, and Argosy sales should certainly benefit from this proposal. It also appears to be the sort of arrangement which should qualify for a Government contribution towards what would be, in effect, development and proving costs.

Meanwhile, Armstrong Whitworth were in the final stages of negotiation last week for the sale of two Argosies to a Middle East non-scheduled operator. Details of this sale may have been made public by the time this issue appears in print, Deliveries should be possible before the end of this year.

Of the 10 Argosies which Armstrong Whitworth laid down as a private venture, six have now flown, and test-flying passed the 1,000-hr. mark in mid-March. Certification trials are well advanced and the C. of A. is expected by June. New weights and performance details for the Argosy, based on these trials, were published in our issue last week (see page 306). The first A.W.660 for the R.A.F. is due to fly later this year and a second batch of 20 is to be ordered soon.

The Air-freight Business

THE more one looks at the prospects for air freight the more obvious it becomes that future expansion on any scale described by the term "break-through" depends on everything clicking together at the right moment. The big specialized all-freight aeroplane needs mechanized and scientifically planned loading; the loading system needs major backing in terminal organization; the loads needed to fill these freighters must be available round the clock; and so on.

Obviously, all these things will never, in fact, click together at the same moment; there may even be interim periods when the big freighters will be empty, or the terminal warehouses packed to the roofs. It will be for the airlines to plan ahead so that they are not caught napping while the break-through develops. As Prof. Stanley H. Brewer put it in a paper published by the Bureau of Business Research of the University of Washington, Seattle: "Interim aircraft of converted piston types . . . will be useful to build capacity during this break-through period. The rapid build-up in capacity will result in greater efforts to develop the air-freight business on the part of the airline operators. These efforts will be necessary to justify the transition to the large long-range turboprop and pure jet freighters that will be offered by manufacturers for delivery towards the end of the break-through period"—mid-1960 to 1964 in the U.S.A., according to Prof. Brewer.

That is how American development is seen by a specialist.

Air Transport . . . .

The progress for European operators may come rather later and the growing-pains may last rather longer—but the same kind of pattern can be expected. Meanwhile, those who are inclined to jump up and down with enthusiasm about recent air-freight increases can relax their muscles. For every freight ton-mile flown by British air operators about 7,000 ton-miles are performed by British surface carriers, and the cost of our air transport is still about 40 times higher than the average for all forms of freighting. Even if sea transport—with its very high total ton-mile figure and very low average rates—is ignored, air ton-mile rates are from 10 to 25 times higher than those for road and rail, and the revenue ton-miles sold amount to only about 0.25% of the total British road/rail transport effort. So we have a long way to go yet and there is a very great deal of prospectively airworthy business still to be attracted.

Another operator to convert older equipment for freight-carrying is Lufthansa, whose cargo figures have been showing steady improvement—including a 48% increase in 1959 out of London Airport. Two of their L-1649As are to be converted in the spring by Lockheed Aircraft Service. The work will include an L-1049H-type floor and new forward and rear cargo doors. The transatlantic payload will be 37,250 lb. Two more L-1649s may be converted later. How are the mighty fallen under the bludgeonings of the turbojets. Lufthansa was one of the few airlines to order the L-1649A, which went into passenger service on the North Atlantic only about 2½ years ago.

Lebanese International Airways

SOME details have been given by Lebanese International Airways of the results achieved in the five-month summer period from April 1, 1959. The company offered a total capacity of 3.8 million ton-miles and flew just over 2.5 million load ton-miles for an overall load factor of nearly 70%. Over 10,000 passengers were carried, in addition to 1.08 million ton-miles of freight and 10,727 ton-miles of mail.

L.I.A. was founded with the help of Sabena, and is now operating a DC-6 and two DC-4s, which are flown by Sabena crews. Lebanese crews are under training and some radio operators and stewards are already serving.

The route network is based on Beirut and cities served include Kuwait, Dhahran, Doha, Bahrein and Baghdad in the Middle East and Paris, Brussels and Milan in Europe. As a first step towards a rationalization of Middle East air services, L.I.A. has concluded a pooling arrangement with other operators on the Beirut-Kuwait route.

Profits and Losses in South Africa

THE Viscount, introduced in the Union of South Africa at the start of 1959, has already, a correspondent writes, brought a spectacular improvement in the financial fortunes of South African Airways on internal and regional services. But international flights are operating at a substantial loss.

Figures given by the general manager of the South African Railways, which control S.A.A., show that, in the seven months ended October 31, 1959, internal flights (excluding coach services) resulted in profits about £104,000 more than in the same period of 1958. Earnings went up by £74,792 to £1,837,609 and expenditure fell by £29,508 to £1,699,390, leaving a profit, for the seven months, of £138,219. In 1957-58 internal services netted a profit of £395,313, but this dropped in the following financial year to £154,773, because of a general decline in passenger traffic ascribed by Airways officials to the economic recession.

Now, continues our correspondent, with economic conditions more buoyant, the Viscount is reversing an unfavourable trend. The general manager praises the Viscount succinctly: "It is highly popular; extremely reliable." Certainly it has justified South African Airways' faith in it, for it made good profits in spite of high depreciation costs (higher on internal services by some £37,000 than in 1958) in its first year of operation. On regional services (to the Federation of Rhodesia and Nyasaland and Lourenço Marques) the Viscount produced a profit of £21,731 in the seven months under review in place of the loss of £15,986 in the same period of 1958.

The latest figures for South African Airways' international operations present a less happy picture. In 1957-58 the Springbok Service netted a profit of £282,813. In the following financial year this became a loss of £58,774 and operations for the first seven months of the 1959-60 financial year, which ends on March 31, have resulted in a loss of £102,764. This service suffered from a general traffic decline on the long-haul routes and also from increased competition. The Wallaby Service to Australia showed a loss of £140,445 in the seven months to October 31, 1959, as against a loss of £49,754 in the same period of 1958.

The general manager of S.A.A. went on to say that the first Boeing 707 was due to arrive in the Union in July, the second in August and the third in September. If things went according to plan all would be operating on the Springbok Service by October. The DC-7Bs would then be put on internal and regional services. He acknowledged that the Boeings would present S.A.A. with problems requiring great adaptability, but that S.A.A. had to keep up with the times and match the equipment of its competitors, otherwise it would lose ground. To attract the necessary passengers S.A.A. intended to introduce economy-class fares.

Pictorial VOR/DME ?

THE Federal Aviation Agency has recently been evaluating the practical results obtainable with two types of pictorial display for use with VOR/DME. This fact demonstrates that the Agency is very conscious of the value of such displays—even if it is critical of the only navigation system (Decca) which has so far offered such pictorial guidance as a basic feature.

The tests formed part of a two-year study of methods for improving the display of navigation information for the pilot and developing A.T.C. procedures which will improve the present airways system. Two devices were used to show the VOR/DME information. One was the F.A.A.'s own Pictorial Display, which indicates the aircraft's position with a spot of light which is followed by an arrow of light to indicate the ground track; the other was the Avion Pictorial Navigation Display on which a "bug" moves across the chart.

During the test programme a total of 220 actual radar-monitored flights were made by day and night, with 240 simulated flights in high-density terminal areas. The results of the simulated flights were checked in the air. An F.A.A. news release said that the tests had demonstrated that the system "significantly reduced the communication workload" and had shown "a trend towards a reduced number of [traffic] conflictions."

The full report became available in New York last week-end. It will be interesting to see whether the conclusions reached in this are, like those in the report on Decca, based on percentages of "yes," "no" and "no comment" answers to broad leading questions, or whether the results are given in more useful quantitative form.

Eagle Airways (Bermuda) has now disposed of both its Viscount 805s and has taken delivery of two ex-Aer Lingus Viscount 707s, as illustrated here. These two aircraft are used for services from Bermuda to Nassau (weekly) and to New York (five times a week with one continuing to Baltimore and one to Montreal). In addition, they are used by Eagle Airways (Bahamas) for four services a day between Nassau and Miami, started on March 1.

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	Original specification	New specification	Increase
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MAX. LANDING WEIGHT	121,000 lb	130,500 lb	**9,500 lb**
MAX. 'ZERO FUEL' WEIGHT	112,500 lb	122,500 lb	**10,000 lb**
MAX. PAYLOAD	29,000 lb	37,000 lb	**8,000 lb**

The Vanguard can now carry 139 economy-class passengers plus over 8,000 lb freight. Without intermediate refuelling, 100-passenger payloads can be carried over such important consecutive sectors as London–Frankfurt–Vienna–Prague.

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TWO NEW TOOLS FOR THE AIRCRAFT INDUSTRY

Among the large range of Desoutter Tools for the aircraft industry are Rackfeed Drills. A group of these are shown here helping to construct the wing section for the Comet Mk 4 at the Hatfield factory of the De Havilland Aircraft Company.

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The Barcelona Accident Report

A VERY short report by the Spanish Director-General of Civil Aviation, dealing with the accident near Barcelona on August 19, 1959, to the Transair DC-3, was issued by the Ministry of Aviation last week. The 15 paragraphs of the translated version do not help to explain the events leading up to the moment when the aircraft hit the 5,620-ft. summit of the Montseny range and, though the accident was deemed to have been caused by an infringement of the regulations, no responsibility was allocated.

The DC-3, G-AMZD, took off from Barcelona at 14.51 hrs. G.M.T. for Gatwick with a crew of three and 29 passengers, all students. At 15.10 hrs. it crashed into the peak, about 75 ft. below the summit, and the resultant fuel explosions caused the wreckage to be scattered over a radius of some 130 ft. All the occupants lost their lives.

The flight, a charter operation, was being made to a VFR flight plan and the weather over the route was stated to have been good except over the Montseny peak, which was enveloped in cloud. The pilot did not, according to the report, advise Area Control that he wished to change to an IFR plan, "nor was he flying at the safe altitude necessary for crossing the [mountain] range. The route followed was not the usual one, but if he had been flying in accordance with an IFR flight plan he would have continued to climb towards Bagur and Cabo Creus and from there he would have headed for Gatwick. From the foregoing," the report continues, "it is to be presumed that the pilot entered the clouds unaware that a mountain, 1,712 m. in height, lay ahead of him."

Steps to Supersonics

ON February 22 Mr. Sandys announced the placing of four study contracts for a supersonic transport. This step cannot be said to imply that the Government has definitely decided that Britain should develop a supersonic airliner. But it is at least a step in the right direction. The past history of this project, and the Minister's mention of collaboration with foreign firms, suggest that it may be many months before a final decision is taken or a development contract placed.

In November, 1956, the Supersonic Transport Aircraft Committee was set up so that the Establishments—in particular the R.A.E.—the Aircraft Industry and the Airline Corporations could collaborate on research. Emphasis was placed on Mach 1.2 and Mach 2 aircraft, because higher speeds would demand steel structures. Early in 1959 the S.T.A.C. submitted its report, which was then referred to the Aircraft Industry for its views.

In July, Mr. Aubrey Jones, then Minister of Supply, said that the Industry did not believe that a medium-range supersonic transport would be economic; it favoured a long-range transport with a minimum cruising speed of Mach 2. Now, seven months later, Mr. Sandys is placing study contracts covering the technical issues, including optimum speed and economic prospects.

Groups receiving the contracts are the British Aircraft Corporation (English Electric/Vickers/Bristol), Hawker Siddeley, Bristol Siddeley Engines and Rolls-Royce. They will, presumably, put the finishing touches to the design studies on which their companies have been working for many months and will submit these to the Minister.

Perhaps the group with the more complex problems in reconciling the views of its constituent companies will be the British Aircraft Corporation. Bristols have done much work on supersonic airliner studies and, in addition, the company has steel-structure experience with the Bristol 188 research aircraft; English Electric has the greatest experience of supersonic flight, albeit with fighter aircraft; and Vickers has had great experience in dealing with airlines and making a commercial success of an airliner. Bristols apparently favour a Mach-3, steel-structured aircraft. Will Vickers' commercial experience endorse such an aircraft?

Hawker Siddeley have been working on supersonic transports for a long time. They had a great deal of useful experience on design work for the supersonic bomber. In deciding whether the threat of a U.S. Mach-3 transport should override the advantages of producing a Mach-2.3 airliner with a light-alloy structure, they have the advantage of a production line producing the all-steel Blue Steel.

Bristol Siddeley and Rolls-Royce are in an interesting position. Both have mentioned specific aircraft projects as well as engines; equally, both will want to provide power for the transport chosen, whichever airframe group produces it. Broadly, Bristol Siddeley favour Mach 3 and combination turbo-ramjet powerplants. Rolls-Royce appear to favour turbojets, with reheat at the higher speeds; the company has also for years been an advocate of the VTOL slim-delta transport with banks of jet-lift engines.

Outside the groups, and presumably without a study contract, is Handley Page, which is building the slim-delta H.P. 115 research aircraft. The company is also the specialist in laminar flow, which is now being proposed to improve the efficiency of supersonic airliners.

When the results of the study contracts are submitted in the near future there are several necessary steps to be taken. Several airlines will presumably be consulted unless the views of B.O.A.C. alone are to be taken into account. Although the Corporation will probably be the only British operator of a supersonic airliner, it has an undistinguished record for predicting its future aircraft requirements. It has studied technical aspects for some time; in addition, last August it set up a supersonic transport syndicate which has been studying, inter alia, the effect of supersonic operations on air traffic control and the size and numbers of aircraft needed to carry the potential traffic. Operational problems appear to have been studied more deeply by U.S. manufacturers than by British ones; B.O.A.C. thus has a key part to play.

If foreign aircraft companies are to collaborate in developing the airliner, they will doubtless do so only if assured of sales and this means that airline views must be taken into account. The British Government, also, will want to produce the aircraft with the best commercial prospects.

Not unnaturally, most of the enthusiasm for supersonic airliners has so far come from manufacturers rather than from operators, who are still digesting the difficulties caused by introducing large subsonic turbojet airliners. For them the supersonic airliner promises much greater problems—of introducing untried aircraft with no background of military operation at the same speed; of unprecedented increases in operating speed; of new operational and A.T.C. problems; and of unknown operating costs. But once an important airline adopts an advanced transport, its competitors have always so far been forced to follow suit.

Many features of the supersonic airliner are still open to dispute. But all agree that it will be very expensive to develop and that the potential market is comparatively small.

It is certain that no British aircraft group has the resources to develop a supersonic airliner—at a cost of £100 million or more. The Government will probably have to hazard much more than the 50% of the cost suggested for current airliners.

A new illustration of the kind of supersonic transport which has been studied by Lockheed. Designed for Mach 3-3.5, it would weigh about 250,000 lb., and would cost $160 million to develop. If 200 were sold, the unit cost would be about $9 million.

Rotary Wings in the R.A.F.

In the early part of 1935, the Royal Air Force started to operate its first Cierva Autogiros. This article, prepared by the Air Ministry, sets out the story of the R.A.F.'s subsequent 25 years of experience with rotary-wing craft.

WHILE some people still regard helicopters as a relatively new form of air transport, it is now more than 16 years since the Royal Air Force began flying them. In fact, the R.A.F.'s first association with rotating-wing aircraft goes back to 1934, so this Service can claim 25 years' experience of such craft.

The first rotary-wing aircraft to be ordered for the R.A.F. was the Cierva C-30 Autogiro, built under licence by A. V. Roe and Co. and known by the R.A.F. as the Rota. Six of these, powered by the 140-b.h.p. Armstrong Siddeley Genet Major, were issued to the R.A.F. School of Army Co-operation at Old Sarum, near Salisbury, in December, 1934.

At the time of the delivery of the first Rotas, Army co-operation was the responsibility of special squadrons equipped with fixed-wing aircraft; but the Autogiro, because of its obviously useful characteristics for these duties, was the subject of investigation by the Air Staff. During the early part of 1935 the School of Army Co-operation introduced a special flying course on the Rota and pilots from the five Army Co-operation squadrons then based in the United Kingdom were trained on the type.

The Rotas took part in the R.A.F./Army combined exercises in September, 1935, and were used for photography and the transport of directing staff. The Autogiro was then the only aircraft which could put down in more-or-less any field, as light aeroplanes of the Auster type with STOL characteristics had not then been developed for the Services.

At the outbreak of the War in 1939, the R.A.F.'s Rotas were supplemented by a number of civil-owned C-30 Autogiros which were impressed into service, along with some Cierva C-40s. This last was a slightly different version with a 175-b.h.p. Salmson engine and "jump take-off" capabilities.

Five C-40s had been ordered by the Air Ministry for issue to the Royal Navy, and two Fleet Air Arm pilots were trained on them. Two of these craft went to France with the British Expeditionary Force in 1939 for Army observation work, flown by R.A.F. pilots. The C-30s and C-40s, some 16 in all, were used at Duxford in 1940 on radar calibration work with No. 1448 Flight, which was formed and commanded by Sqn. Ldr. R. A. C. Brie, formerly Cierva's chief test pilot. On June 15, 1943, No. 1448 Flight was re-formed at Halton as No. 529 Squadron, under the late Sqn. Ldr. H. A. Marsh, who had replaced Brie as commanding officer in 1941.

For radar calibration work the Rotas operated as independent units with a pilot, engine fitter and rigger. These units moved around the coastal radar stations, and the aircraft flew out to sea to send back signals to be picked up by the radar stations. On arrival at the series of pre-arranged points the Rota dropped a sea-marker and orbited it at a known height.

No. 529 Squadron moved to Upper Culham Farm, Henley-on-Thames, on August 19, 1944, and was not disbanded until October 20, 1945.

The R.A.F.'s First Helicopters

After forming No. 1448 Flight, Wg. Cdr. Brie, as he had then become, having been loaned to the Admiralty, went to the U.S.A. with the British Air Commission in September, 1941, to investigate the use of helicopters for anti-submarine duties on British merchant ships. There he flew the experimental Sikorsky XR-4 helicopter (becoming the first British pilot to do so) and quickly realized its possibilities.

The Royal Navy became interested to the extent that it ordered, on Brie's recommendation, a quantity of R-4s and R-5s, which were being developed from the XR-4. Some flying personnel were detached to Floyd Bennett Field, New York, in 1943, for training on the R-4s, but as at that time the Navy had had no experience of helicopter pilot training, some pilots from No. 529 Squadron were posted there to assist with their specialized knowledge. A joint R.N./R.A.F. unit was formed with the co-operation of the U.S. Coast Guard.

At Brie's request, Flg. Off. (later Sqn. Ldr.) F. J. ("Jeep") Cable*, from No. 529 Squadron, had been posted to America in 1942 to learn to fly the YR-4 helicopter and to evaluate those ordered for the Navy. In November, 1943, Brie and Cable, with a Navy pilot, made trials on the M.V. "Daghestan" off the coast of America with two YR-4s (180-b.h.p. Warner Super-Scarab) fitted with pontoons for seaborne trials and made tests from a platform on the ship's deck. These were the first helicopter trials from a British merchant ship.

Later, trials were conducted in convoy (on the "Daghestan") across the Atlantic in January, 1944. These aircraft (which were known by the R.A.F. as the Hoverfly I) were taken to Hanworth, where General Aircraft had acquired the Sikorsky overhaul licence. There, Brie and Cable started a pilot training school—the first use of helicopters in the United Kingdom.

Towards the end of 1944, the Royal Navy decided not to go ahead immediately with the use of helicopters, and cancelled the order for the R-5s, although a tentative interest was retained with the R-4s it already had.

There were also in the United Kingdom some R-6 (or Hoverfly II) two-seaters (245-b.h.p. Franklin) which were used by the R.A.F. and later by the Army. The R-6 was not very satisfactory because of numerous engine failures, the result of faulty oil seals causing magneto flooding.

Above, an R.A.F. Cierva C-30 Autogiro—the Service name for these craft was Rota. Below, a C-30 being manhandled by an R.A.F. groundcrew.

* He subsequently lost his life with Alan Marsh in the Cierva Air Horse in 1950

As the Navy at this time was tentatively investigating the use of the R-4s for air/sea rescue work, the R.A.F. went on to other experiments. At the beginning of 1945, nine R-4s were brought to the U.K. and formed into the Helicopter Training School at Andover with the specific intention of converting Army A.O.P. squadron pilots to fly them. The commanding officer of the School was Sqn. Ldr. B. H. Arkell, from No. 529 Squadron.

A five weeks' course, including 30 hours' flying on the R-4, was instituted. There was a Maintenance School, and an instructional course was provided for ground engineers.

The first two courses were for converting all the Rota pilots of No. 529 Squadron to fly the R-4, and an R-4 was in fact added to the strength of the squadron for experimental use and to provide comparison flying with the Rota. At Andover, 12 Rota pilots were converted, and then Army squadrons equipped with Austers flew in from Germany to learn to fly the R-4.

Other experiments in which the R.A.F. was engaged were with the Telecommunications Flying Unit of the Ministry of Supply's Telecommunications Research Establishment at Defford in 1946-48.

In 1947, an R-4B, flown and serviced by R.A.F. personnel, was used in a variety of trials connected with radar development. Much calibration work, for example, was done using a 2-ft. metal ball suspended 1,400 ft. below the helicopter flying at heights of up to 6,000 ft. The ball, of known radar response, was lowered from the helicopter, which was then held so that the ball maintained a position above a specific point on the ground.

Earlier that year this helicopter had been used to report amounts of snowfall in parts of the Midlands, giving extent, estimated depths and the state of the roads, etc., and for reconnaissance over the subsequently flooded areas. It was also engaged in simulating the flight of a balloon for radio sonde trials, drifting up with a very slow rate of climb and speed; and in trials of the Airfield Surface Movement Indicator.

When the R.A.F. had exhausted the possibilities of the R-4 and R-6, and concluded that they could not be used operationally, these aircraft, all except one R-4, were handed over to the Army and the Royal Navy for their own trials. The one retained was used by The King's Flight for the carriage of light freight and mail to Balmoral, flown by Flt. Lts. A. J. Lee and E. B. Trubshaw.

The Army established an experimental flight with their R-4s and R-6s, experience with which subsequently led to the formation of the helicopter element of the Army Air Corps and the Joint Experimental Helicopter Unit. J.E.H.U. (formed on January 1, 1954, and disbanded on December 31, 1959) was brought into being to determine the type of helicopter best suited for light supply work with the Army in the field: to investigate the possible use of armaments, and to undertake other experimental work. It was functionally controlled by the War Office; maintenance and servicing were R.A.F. commitments. Half the pilots were from the R.A.F., half from the Army.

Nearly 100 Army pilots qualified on the R-4 and R-6. Sqn. Ldr. Cable took the two original R-4s to the Airborne Forces Experimental Establishment, which had been formed from the R.A.F. pilots who had been trained at Andover, first at Sherburn in Elmet, Yorkshire, and later at Beaulieu, for experimental work.

Following the Hoverflies came the Westland-Sikorsky S-51, a development of the R-5, which was the first helicopter with an operational capability. Powered by a 500-b.h.p. Alvis Leonides it was produced for the R.A.F. by Westland Aircraft as the Dragonfly HC.Mk.2, and first deliveries were made in 1950.

In April, 1950, the first of these types were taken to Soletar, Singapore, and formed into the Casualty Evacuation Flight, F.E.A.F., to fly on jungle rescue work in Malaya, where R.A.F.

Above, one of the R.A.F.'s first helicopters, the Sikorsky R-4. Below, early amphibious operations—an R.A.F. R-4 on pontoons.

Above, loading mail into an R-4 of The King's Flight in 1947. Below, a Sikorsky R-6 with externally mounted stretchers.

units were operating against the Terrorists. The Flight was commanded by Flt. Lt. K. Fry. Three Dragonflies were used initially, the first of them flying on April 28, and the number was later increased. This Flight was the first British operational unit equipped with helicopters, which were the only helicopters then in Malaya.

The Casualty Evacuation Flight later moved to Changhi. It took part in a great variety of operations, and in its primary rôle as a rescue unit was equipped to carry a stretcher. This, a canvas-lined basket structure weighing 35 lb. and cheaply produced, was carried internally in the Dragonfly. Originally two metal panniers were fitted, one on each side of the fuselage and together weighing 210 lb.; but in the conditions obtaining it was found that a single stretcher carried internally allowed better operation, besides making the patient more comfortable.

Another activity in 1950 was crop-spraying. It was found that the special pasture of the only dairy herd in Singapore was in urgent need of chemical treatment. Spray gear was designed, made and fitted to a Dragonfly overnight, and the task completed in 24 hours. This operation may be regarded as one of the practical forerunners of the commercial helicopter crop-spraying activities which later come into being.

There was also a rather specialized application of crop-spraying. In 1952, when General Templar was High Commissioner in Malaya, his policy of denying food to the Terrorists by protecting the civilian population in new towns was beginning to be effective, and the Terrorists retreated deep into the jungle to begin growing food in clearings. Their crops were readily destroyed by Dragonflies, whose pilots had little difficulty in distinguishing between bandit cultivation and aborigine food-growing areas.

An entirely unexpected use for the helicopter—as a tactical air-strike weapon—was developed as early as 1951, when a civilian car was ambushed on a lonely road at the most dangerous time of the day—evening—when retaliatory action by the Security Forces was impossible before next day. On this occasion the driver escaped from the ambush and drove back to the nearest village, where a Dragonfly happened to be positioned for another operation. At short notice it was arranged that the driver of the car should fly in the helicopter, accompanied by a soldier with a Bren gun, to the scene of the ambush, and a few minutes later the surprised Terrorists found themselves shot up from the air.

A most important feature of the Malayan operations was, naturally, Intelligence and in this respect it was vital to

A Dragonfly and stretcher party in Malaya.

interrogate captured Terrorists as soon as possible. The helicopter made this possible to a previously undreamt of degree. The interrogation was obviously highly specialized and conducted in Chinese, and so could not normally be done by the first captors on patrol. To return with the prisoners would cancel the effectiveness of the patrol, and made vital follow-up operations too late to be effective. A journey which might take five days in jungle could be done by helicopter in 20 minutes.

This service was also frequently used for transferring the many documents found in evacuated Terrorist camps. Similarly, identification of dead Terrorists was a most important feature of the operations, and a special cage was built for carrying the bodies suspended below the aircraft. On September 11, 1952, a portion of a bandit armoury was flown out by a Dragonfly, operating from Grik, for examination.

The first helicopter trooping task was made in 1951 in conjunction with the first use of parachute troops in Malaya. A complete valley in remote North-Central Malaya was evacuated of its aborigine population following a three-weeks' operation by parachute troops of No. 22 Special Air Service Regiment.

For the whole period, regular helicopter flights were made in support of troops, and at the end of the operation all the inhabitants who could not make the arduous seven-day trek through jungle to their resettlement village were lifted out by helicopter. Many valuable lessons were thus learnt at an early date, and were put to good use in developing trooping operations until they became a major factor in the fight against the Terrorists.

In 1952 a complete patrol of 17 men of the Cameronians, plus a captured Terrorist, were lifted from a very small clearing which they had managed to cut in the jungle. The men, all exhausted and sick after 29 days in jungle swamp, 13 days' travel from safety, hardly able to move and surrounded by Terrorists, were carried out by Dragonfly, one man at a time. Piloting the Dragonfly was Flt. Lt. J. R. Dowling. This operation well demonstrated the helicopter's ability for this sort of work, even though the swamp did not permit a proper landing platform to be built.

R.A.F. helicopters played a supreme part in the establishment of the jungle forts where the evacuated population was resettled. The Terrorists had established control over many thousands of aborigines, and these centres were provided so that the Malayan Government could regain control over them. In this way education, medical attention, assistance and general welfare were provided for the first time for the tribesmen. The forts are now permanent bases, to which troops can be sent either by surface or by air. Landing strips have been provided for supply operations by Pioneer aircraft, although some of the forts are still accessible only by helicopter.

The Casualty Evacuation Flight was re-formed at Sembawang, on Singapore Island, on February 1, 1953, as No. 194 Squadron, the R.A.F.'s first helicopter squadron. By the end of November, 1954, the Dragonflies operating in Malaya had completed 5,946 sorties in 4,934 flying hours; evacuated 675 casualties from the jungle; carried 4,213 passengers on communication and reconnaissance flights, and 84,524 lb. of supplies.

Operations in Malaya were of special significance because they were the first operations which represented the initial breakthrough into the flying techniques involved in military

A Whirlwind of No. 155 Squadron flying over some bleak Malayan territory.

helicopter operation. The Dragonflies were not withdrawn from Malaya until June 29, 1956. The HC Mk. 4, a modified version with metal rotor blades and more suited for tropical work, was introduced to the R.A.F. in 1952.

The R.A.F. instructed the Army in helicopter techniques, and the operations were the result of successful co-operation between the R.A.F. and the A.O.P. organization. One advantage when planning operations against the Terrorists was that Army officers were able to see suitable clearings from the air; these could seldom be seen by troops on the ground, even when within a very short distance of them.

Up to February, 1953, the R.A.F. helicopters were the only helicopters in Malaya, but thereafter some Sikorsky S-55s of the Royal Navy were diverted there to operate in a complementary capacity with No. 194 Squadron. The Navy's first helicopter operation in Malaya — "Wellington Two" — made on February 16, 1953, was the capture of a Terrorist headquarters near Port Swettenham. Three S-55s were led to the scene by a Dragonfly of No. 195 Squadron, all of whose pilots knew the country well from their long experience. On arrival the Dragonfly hovered immediately outside the door of the house, covering it with a Bren gun, while the S-55s deplaned their troops around the house.

Enter the Sycamore

Meanwhile the Bristol company had been developing the Type 171 Sycamore (520-b.h.p. Leonides) and a rescue and anti-submarine version entered service with the R.A.F. on February 19, 1952, the first (an HR Mk. 12) going to St. Mawgan for trials with Coastal Command. Later versions—the HR Mk. 13 and HR Mk. 14—are used by Fighter Command, initially joining No. 275 Squadron at Linton-on-Ouse on April 13, 1953, which was re-formed by Sqn. Ldr. D. C. L. Kearns as the R.A.F.'s first search-and-rescue helicopter squadron in Great Britain. This squadron moved to Thornaby on November 18, 1954, and in 1959 was renumbered as No. 228 Squadron.

In 1954, the Sycamore supplemented the Dragonfly in No. 194 Squadron in Malaya, and in November, 1956, equipped No. 284 Squadron at Nicosia, Cyprus. With the latter squadron, Sycamores were flown by night as well as by day; they were used to good effect during the Mau Mau operations in Kenya.

During the Suez campaign in 1956 six Sycamores and six Whirlwinds of J.E.H.U. were embarked in H.M.S. "Ocean" and made the Commando assault landing at Port Said; later they helped to establish a base at Gamil airfield. In these operations Sqn. Ldr. Kearns gained the D.S.C.—the first to be awarded for helicopter operations.

No. 228 Squadron, based at Leconfield, has achieved many notable successes with Sycamores on air/sea rescue work, including the recovery of the crew of five of the North Carr lightship, which broke its cable in December, 1959. Helicopters have now almost entirely replaced the R.A.F.'s marine craft for air/sea rescue work.

Also with the R.A.F. in Malaya, from 1954, was the Westland Whirlwind (600-b.h.p. Pratt & Whitney R-1340) which was issued to No. 155 Squadron at Kuala Lumpur for jungle rescue and transport work. This aircraft, generally similar to the Sikorsky S-55, carries a crew of three and up to eight passengers. The F.E.A.F. version is designated the HAR.Mk.4; the HAR.Mk.2 forms an important part of Coastal Command's search-and-rescue organization in the United Kingdom, equipping No. 22 Squadron.

This unit was re-formed on February 2, 1955, at Thorney Island, by Sqn. Ldr. P. C. Bowry, and equipped with two Sycamores and four Whirlwinds. It is now based at St. Mawgan and is frequently involved in locating disabled ships, missing aircraft or swimmers in difficulties. Both the winch and scoop-net methods of rescue are used. In the case of the winch, a double-hoist method is used, whereby the winchman is lowered to the victim by line, wraps a harness around him, and supports him while rescuer and rescued are winched up together into the helicopter.

Detachments from Nos. 22 and 228 Squadrons are permanently based at Leuchars, Acklington, Horsham St. Faith, Felixstowe, Chivenor, Valley, Leconfield and St. Mawgan. Although the R.A.F.'s search-and-rescue organization is primarily to assist in Service incidents, by far the greater number of operations in 1959 concerned civilians. There are also many instances of helicopters being engaged on mercy missions, carrying emergency cases, drugs and vaccines to hospitals.

The latest application of the Whirlwind is its use by The Queen's Flight at Benson, where two HCC.Mk.8s, specially soundproofed for use by the Royal Family, are based.

Other Developments

Another type used by the R.A.F. is the Saro Skeeter (215-b.h.p. Gipsy Major), one of which is based at the Central Flying School at Little Rissington for the instruction of Army helicopter pilots.

Now being evaluated for the R.A.F. is the Bristol Type 192 twin-rotor transport helicopter powered by two Napier Gazelle turbines, and able to carry 18-25 fully armed troops. This helicopter was recently given the name of Belvedere for Service use.

Sycamores are also operated by the Central Flying School, and some of them flew in the *Daily Mail* Arch-to-Arc race of July, 1959, operating the legs between city and airfields, and contributing to the R.A.F.'s achievement in gaining first and third places.

This type is also flown by No. 118 Squadron at Aldergrove and at the Air/Sea Warfare Development Unit at Ballykelly. Two are shortly to be added to the Metropolitan Communications Squadron at Northolt. Overseas, Sycamores fly on air/sea rescue work with No. 103 Squadron at Nicosia, and No. 110 Squadron at Kuala Lumpur.

With the disbandment of J.E.H.U. its Sycamores and Whirlwinds were re-formed, on January 1, 1960, into No. 225 Squadron at Andover, commanded by Sqn. Ldr. A. Twigg. This unit comes within No. 38 Group, the tactical support formation which came into being on the same day within R.A.F. Transport Command.

R.A.F. pilots have, by continuity of posting to helicopter units, accumulated many thousands of hours of helicopter flying; a large number have achieved well over 1,000 hours each.

Some idea of the restricted areas from which helicopters have been operated in the Malayan jungle is given by this photograph of a Sycamore of No. 194 Squadron in a small clearing.

Photograph copyright "The Aeroplane and Astronautics"

The Fleet Air Arm's New Generation

Photographs copyright "The Aeroplane and Astronautics"

FOR once the Fleet Air Arm has aircraft superior to comparable types in the R.A.F. On Mar. 4, H.M.S. "Ark Royal" (Capt. P. J. Hill-Norton, R.N.) sailed from Devonport and, in the Lyme Bay area, embarked three of the Navy's new generation of aircraft—Scimitar, Sea Vixen and Gannet AEW.3—to join the two Whirlwind helicopter squadrons already on board. Since the "Ark" herself has almost every modern refinement, including the new projector landing lights which replace the mirror system, the unit will be, when it is fully worked up, the most formidable the Fleet Air Arm has ever had at its command. Rear Admiral R. M. Smeeton, M.B.E., Flag Officer Flying Training, who is flying his flag in the ship for part of its seven-month voyage, said that the occasion marked what was probably the Arm's biggest step forward since the War.

Capt. P. J. Hill-Norton, R.N., captain of H.M.S. "Ark Royal."

H.M.S. "Ark Royal," the fourth of the name, was laid down in 1943 and was commissioned for the third time on Dec. 28 last, after a 14-month refit. She was the first carrier in the World to have all three of the British inventions, the angled deck, steam catapult and mirror landing sights, and now the projector landing lights devised by R.A.E. Bedford in collaboration with the Navy. With a complement of more than 2,000 men, she is visiting Gibraltar, Malta, Palermo, Naples and Barcelona, and later takes part in autumn and NATO exercises.

Another British idea is her system of flight deck communication. The deck has an electro-magnetic loop around its boundary and the Flight Deck Officer, plugged in to a below-deck transmitter, can broadcast instructions to his crewmen which they pick up in their headsets through a miniature transistor receiving set, eliminating connecting wires and allowing free movement.

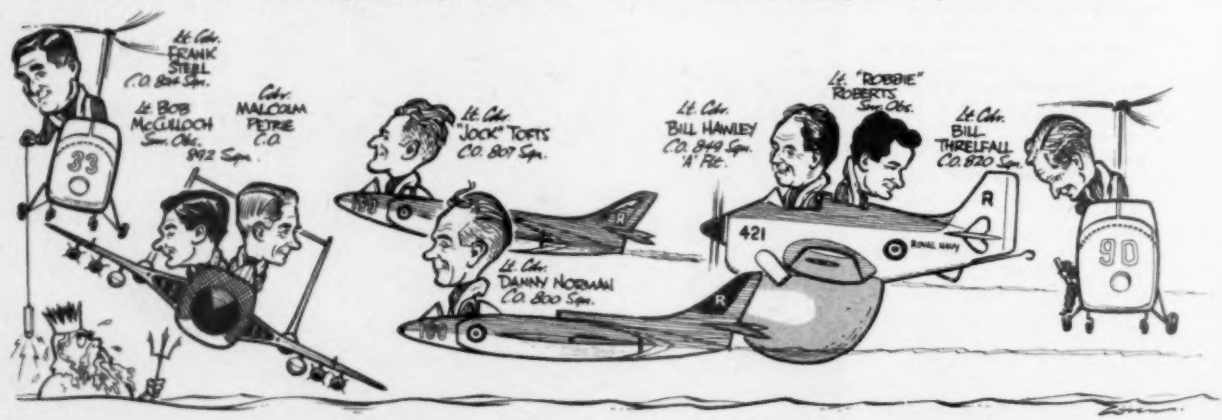
Additionally, "Ark Royal" has closed-circuit television, paid for by the crew with help from private sources. It is used for the information and entertainment of the ship's company. The ship also has CCA (Carrier Controlled Approach) and a system of remote control as protection against radioactive fall-out. It has not, as yet, the "3-D" radar presentation which equips H.M.S. "Victorious."

Rear Admiral R. M. Smeeton, Flag Officer Flying Training, and a wartime C.O. of No. 800 Sqn.

The two helicopter squadrons, each of six Westland Whirlwinds (Alvis Leonides) were Nos. 820 (Lieut. Cdr. W. W. Threlfall) and 824 (Lieut. Cdr. F. K. Steel). The "choppers" are used for sea-air rescue patrol during flying operations and to provide protection, using sono-buoys, against submarines.

From Lossiemouth there flew on two Vickers-Supermarine Scimitar squadrons, Nos. 800 (Lieut. Cdr. D. P. Norman, A.F.C.) with six aircraft and 807 (Lieut. Cdr. W. A. Tofts, A.F.C.) with a full squadron of eight. Powered by two Rolls-Royce Avons, the Scimitar's rôle is that of single-seat fighter-bomber, using a variety of weapons, including the atom bomb, and able to employ the Low Altitude Bombing System.

The D.H. Sea Vixen, also powered by two Avons, is a two-


Lt. Cdr. FRANK STEEL C.O. 824 Sqn.
Lt. BOB McCULLOCH Sen. Obs. 892 Sqn.
Cdr. MALCOLM PETRIE C.O.
Lt. Cdr. "JOCK" TOFTS CO. 807 Sqn.
Lt. Cdr. DANNY NORMAN CO. 800 Sqn.
Lt. Cdr. BILL HAWLEY CO. 849 Sqn. 'A' Flt.
Lt. "ROBBIE" ROBERTS Sen. Obs.
Lt. Cdr. BILL THRELFALL CO. 820 Sqn.
33
421
90
R
ROYAL NAVY

Right, the pilots and observers of No. 892 Sea Vixen Squadron. Cdr. M. H. J. Petrie, the C.O., is standing next to Lieut. Cdr. D. N. Hamilton, chief pilot who is C.O. designate. On the right of the picture are Flt. Lt. C. Holmes, R.A.F., and Capt. C. Battistone, U.S. Marine Corps.

Left, pilots and observers of No. 849 Sqn. "A" Flight's Gannets. Next to the C.O., Lieut. Cdr. W. Hawley, is his bearded chief pilot, Lieut. Cdr. W. H. Barnard.

man all-weather fighter, the observer being totally enclosed with his radar screen. No. 892 Sqn. (Cdr. M. H. J. Petrie) flew on eight Vixens from Yeovilton, some carrying Firestreak missiles. A full squadron will consist of twelve aircraft.

Finally, four Fairey Gannet AEW.3s (Bristol Siddeley Double-Mamba) of 849 Sqn. "A" Flight (Lieut. Cdr. W. Hawley) flew on from Culdrose.

One problem with the new large aircraft is deck handling, now almost beyond physical endeavour. Mechanical handlers are employed, but the confined limits of the flight deck, lifts and hangars demand accurate positioning of the aircraft, which must be done quickly. Another is the greater wear and tear on arrester wires; another is the danger from the double jet blast.

As with all modern aircraft, the extent and complexity of electrical and electronic accessories impose an immense responsibility on the electricians, a state of affairs also applicable to the ship with its vast assembly of radar and radio gear.

During the five days that I was with the "Ark," numerous launches and recoveries were made and a high standard of airmanship and seamanship demonstrated. One successful exercise was the locating, by a Gannet, of a target, consisting of some R.N. frigates, and the subsequent swift "attack" by Scimitars. Cdr. R. Reynolds, Cdr. (Air), and Lieut. Cdr. B. Bevans, Lieut. Cdr. (Flying), and all on board, have much to do during this working-up period. The outcome will be seen later when the "Ark Royal" and her squadrons take their place as a formidable unit in the Western armoury.—WREN.

A Gannet AEW.3 of No. 849 Sqn. "A" Flight, is struck down to the lower hangar while a No. 820 Sqn. Whirlwind rests in the top hangar.

"Ark Royal's" four aircraft types are ranged, and the crew assembled, as the carrier enters Gibraltar harbour.

The Fighting Services

A.D.C.s to Her Majesty

FOUR officers, Air Cdre. H. I. Edwards, V.C., C.B., D.S.O., O.B.E., D.F.C., Gp. Capt. W. D. Hodgkinson, D.F.C., A.F.C., Gp. Capt. L. A. Jackson, C.B.E., and Gp. Capt. J. H. Stevens, O.B.E., have been appointed Aides-de-Camp to H.M. the Queen, with effect from March 8.

Air Cdre. Edwards is Commandant of the Central Fighter Establishment, R.A.F. West Raynham, and previously commanded R.A.F. Habbaniya. Gp. Capt. Hodgkinson commands R.A.F. St. Mawgan, Gp. Capt. Jackson is serving with Allied Forces Central Europe at Fontainebleau, and Gp. Capt. Stevens is at present Director of Studies at the R.A.F. Technical College, Henlow.

Ground Attack in Aden

FOLLOWING the completion of conversion to Hunter FGA.9s, No. 8 Squadron at R.A.F. Khormaksar, Aden, recently demonstrated its paces to the Air Officer Commanding, Air Forces Arabian Peninsula, Air Vice-Marshal D. Lee. At present commanded by Sqn. Ldr. R. Knight, No. 8 has been the Colony's resident ground-attack squadron for most of the past 32 years.

The A.O.C. was welcomed to the station by Gp. Capt. J. R. H. Merifield, and then given a full display of squadron activity. After inspecting eight Hunter FGA.9s, two Hunter T.7s and ground equipment, he was taken by helicopter to a rocket range to see a demonstration of rocket and cannon firing by the Squadron.

On his return to Khormaksar, the A.O.C. watched an operational turn-round of aircraft and saw a film on air-to-ground and air-to-air tactics. The morning's programme concluded with four Squadron flypasts of 10 Hunters in different close formations.

Powered by one Rolls-Royce Avon 203 turbojet, the first prototype Hunter FGA.9 flew on July 3 of last year. Based on the F.6, it is fitted with an 8-ft. ring-slot landing parachute and is specially equipped for ground-support duties in the Middle East. It has the ability to carry 230-gallon drop tanks in addition to ground-attack stores, such as 24 12-lb. rockets.

High-altitude Flying

TO meet the growing demand for special aeromedical training for bomber and fighter aircrew, a permanent instruction centre has been established at R.A.F. Upwood. Known as the Aeromedical Training Centre and under the control of No. 1 Group, Bomber Command, the unit will operate a five-day course of lectures and demonstrations for aircrew. These will include decompression tests and checks of individual flying clothing and survival equipment.

Until now such training has been given to test pilots and other selected aircrew at the R.A.F. Institute of Aviation Medicine, Farnborough, which will provide medical officers from its High Altitude Section until the new centre is ready. Commanding Officer of the centre will be Sqn. Ldr. W. L. Aikman, M.B., Ch.B., who is to have a staff of three other medical officers, two personal flying equipment officers and 10 specialist airmen.

Desert Mobility Trials

SINCE Thursday of last week the first phase of the most ambitious joint Army-R.A.F. air mobility exercise ever held outside the United Kingdom has been under way. Known as "Starlight," the exercise is taking place in Cyrenaica with the permission of the Libyan Government and in co-operation with Middle East land and air forces.

It is the latest of the recent series of Strategic Reserve air mobility trials and involves strategic, tactical and short-range aircraft of Transport Command. Four Britannias of No. 99 Squadron from R.A.F. Lyneham and 17 Hastings of Nos. 24, 36 and 114 Squadrons from R.A.F. Colerne are operating a shuttle service between Lyneham and El Adem, the staging post 16 miles south of Tobruk. In addition, nine Beverleys of Nos. 47 and 53 Squadrons are ferrying Land-Rovers and trailers from Abingdon.

The first phase, the strategic air lift of troops, equipment and vehicles, continues until March 20. During this period the Britannias are flying non-stop to El Adem, where they have been slipping crews, and the Hastings have staged through Malta. The exercise operational headquarters of No. 38 Group, the new Transport Command specialist tactical air transport formation based at R.A.F. Upavon, has also been established.

IN SERVICE.—The Hunter FGA.9, the new ground-attack fighter ordered by the R.A.F. for service in the Middle East, is now in operation with No. 8 Squadron, Aden.

The Group's A.O.C., Air Vice-Marshal P. G. Wykeham, is the R.A.F. commander for these trials.

Preparations for "Starlight" started last month when 12 Whirlwinds of No. 225 Squadron at Andover, six Pioneers and two Twin Pioneers of No. 230 Squadron, together with ground crews and stores, were positioned at El Adem. The helicopters were transported by Beverleys. Transport Command Beverleys are also to be joined during the exercise by others from Nos. 30 and 84 Squadrons from Aden and Kenya and by two Hastings of No. 70 Squadron based at Cyprus.

The second phase, which is operating simultaneously with phase one, covers the setting up of an air head at Timimi, 50 miles north-west of El Adem, and the concentration of the ground forces there by air. From March 21 to March 27 the actual battle exercise, or third phase, will test the operational and logistic air support of troops fighting up to 50 miles west of the air head. Flying on a more or less round-the-clock basis, the Pioneers and Whirlwinds will daily carry forward from Timimi some 60 tons of ammunition, fuel, food and water. The Beverleys and Hastings, operating from El Adem, will supply an equivalent daily load by parachute drop.

Fighter support for the Strategic Reserve will be provided by six Hunters from Stradishall operating from El Adem and by the aircraft from the carrier "Albion."

Then and Now

IN a written reply to a recent question in the House of Commons on the comparative strength of the R.A.F. and its auxiliaries on April 1, 1939, and April 1, 1959, the Secretary of State for Air gave a number of interesting comparisons.

The number of aircraft on June 1, 1939, was 9,702, compared with 5,194 on April 1 of last year. The relative aircrew numbers, including those under training, were 8,554 and 13,616, and the total of officers and men other than aircrew was 105,202 and 161,225 respectively.

In comparison, the number of Air Commodores and above in 1939 was 84 and in 1959 was 250. The number of personnel below air rank were 113,672 and 174,591 respectively. There were 14 Commands and 19 Groups just prior to the War, compared with 12 Commands and 17 Groups last year.

R.A.F. Appointments

THE following are among recent Royal Air Force appointments:—

Air Ministry: Gp. Capt. C. S. Harley and Wg. Cdr. N. Wilson, O.B.E., both to the Department of the Air Member for Personnel; Wg. Cdr. P. J. S. Shaughnessy, D.F.C., A.F.C., to the Department of the Chief of the Air Staff.

Bomber Command: Wg. Cdr. W. N. Gilmer, A.F.C., to R.A.F. Finningley, to command the Bomber Command Development Unit.

Transport Command: Wg. Cdr. R. Wood, D.F.C., to R.A.F. Dishforth, as Chief Instructor.

Flying Training Command: Wg. Cdr. W. J. Winter, D.F.C., to R.A.F. Hornchurch, to command; Wg. Cdr. H. P. Hopkins, M.B.E., A.F.C., to R.A.F. Shawbury for training duties.

Technical Training Command: Wg. Cdr. E. J. Ough, B.Sc., to Headquarters No. 24 Group for education staff duties; Wg. Cdr. F. D. Pryce to Air Ministry Unit, Kenley, for accounts duties; Sqn. Ldr. A. A. Witherington to the R.A.F. Police Depot, Netheravon, to command the training wing, with the acting rank of Wg. Cdr.

Other Appointments: Wg. Cdr. H. L. Jones to the Ministry of Defence; Wg. Cdr. N. F. Smith, D.F.C., to the School of Work Study, as Officer Commanding and Chief Instructor.

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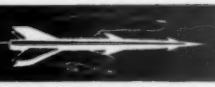
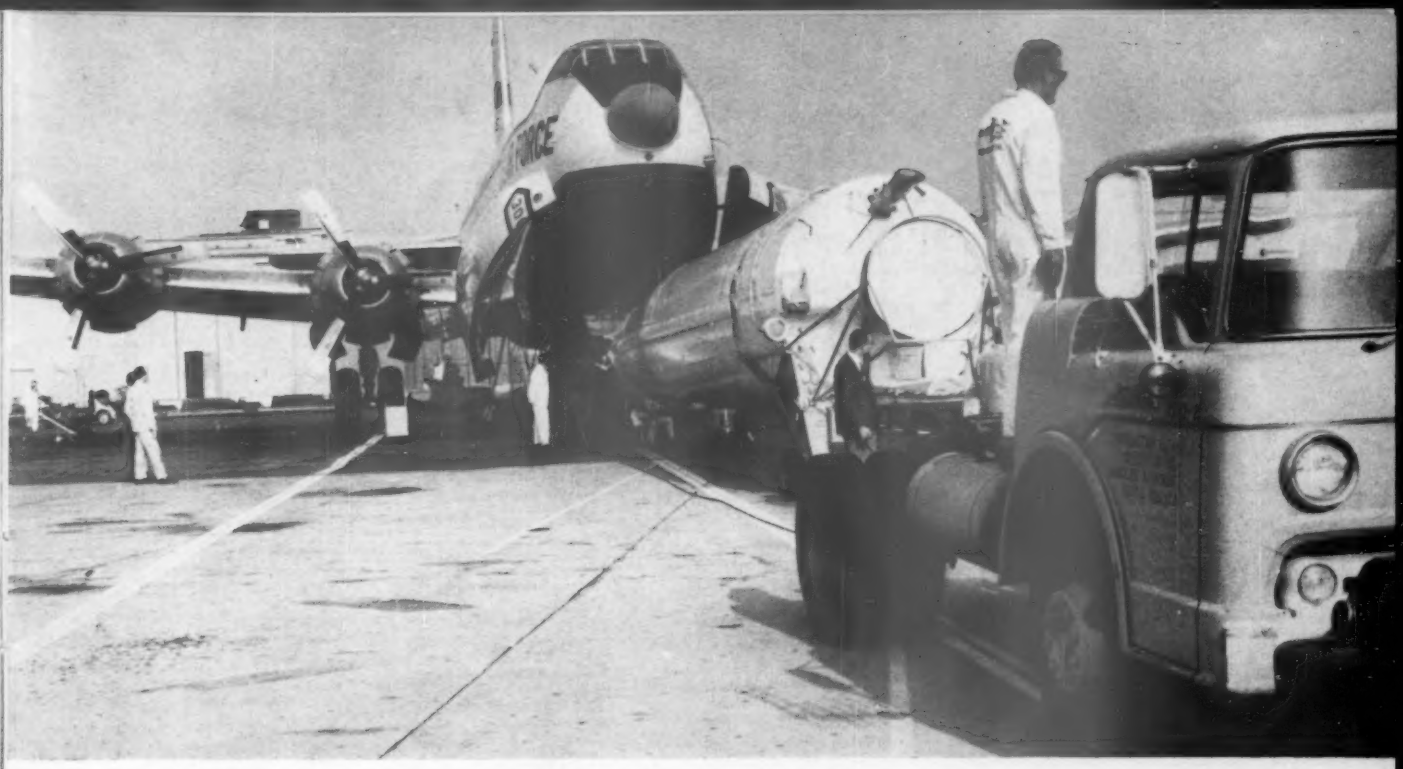




Bringing the Sixtieth Thor to England

by J. R. Cownie

MORE than 11,000 tons of equipment for R.A.F. Thor bases have been air-lifted from the U.S. to Britain in the past 18 months; in addition over 8,000 tons have gone by sea. The airlift, by the Military Air Transport Service of the U.S.A.F.—known as MATS—has involved 600 flights by Douglas C-124 Globemasters and 77 by Douglas C-133 Cargomasters.

This unprecedented supply by air of almost an entire ballistic-missile weapon system culminated last week in the delivery to Britain of the R.A.F.'s 60th, and last, Thor IRBM. It was flown into North Luffenham, in Rutland—the central establishment of the fourth R.A.F. Thor base; a visit to the first base at Feltwell was described in THE AEROPLANE AND ASTRONAUTICS for February 19.

Through the courtesy of the U.S.A.F., I travelled from Santa Monica on this delivery flight. The journey also gave an opportunity of learning about the operations of MATS and of the logistic support arrangements made in the U.S. for the Thor.

My journey to the U.S. started at Mildenhall, in Suffolk, on Thursday, March 3, where I boarded a MATS C-118 passenger transport (military version of the DC-6) and flew in it via Prestwick and Harmon A.F.B. in Newfoundland to McGuire A.F.B. in New Jersey. This is the main MATS passenger terminal in the United States. The weather was very bad on arrival, the eastern States having been hit by a snow blizzard, and the journey on to California—scheduled from Dover A.F.B., Delaware—was delayed until the morning of Sunday, March 6. Dover A.F.B. is the main air-cargo base of MATS and proudly claims to be "the largest air-cargo terminal in the World." With 74 Globemasters alone assigned to it, this claim is easy to believe.

On arrival at Base Operations on the morning of departure I met the crew from the 40th Air Transport Squadron with whom I was to fly in a C-124C Globemaster as far as Santa Monica and back to Dover with the last R.A.F. Thor aboard. Another crew was to relieve them for the return transatlantic crossing to North Luffenham. For "Stateside" trips the normal C-124 crew is three pilots, two engineers and a load master; for ocean crossings two navigators are carried in addition.

During the short crew briefing, mention was made of a ban on "crowd-pleasing manœuvres." We were to fly direct to

Top, Thor on its transport dollies and the winching vehicle prior to loading at Santa Monica.

Right, loading Thor into the Globemaster is accomplished by winching it up the ramp through the clamshell doors.

Photographs copyright "The Aeroplane and Astronautics"

Santa Monica, with Long Beach as an alternate; the flight was planned to take 12 hr. 18 min. It was mentioned, too, that as this was the last Thor flight two colonels and a major-general might be returning with the missile.

The C-124 is the mainstay of the MATS cargo fleet; a massive and somewhat ugly 185,000-lb. transport, it can be used for trooping as well as freighting. For freighting the floor of the upper deck can be removed or folded against the fuselage sides. Freight and vehicles can be loaded either up a ramp through clam-shell doors in the nose or via a power-operated lift which forms part of the floor in the rear fuselage.

Maximum cargo capacity is 74,000 lb., but less than half this load is carried on transatlantic flights. Nevertheless, a Thor, although a long and awkward load, is a comparatively light one for the C-124 as complete with its transport dollies, but without warhead, it weighs only 10,750 lb.

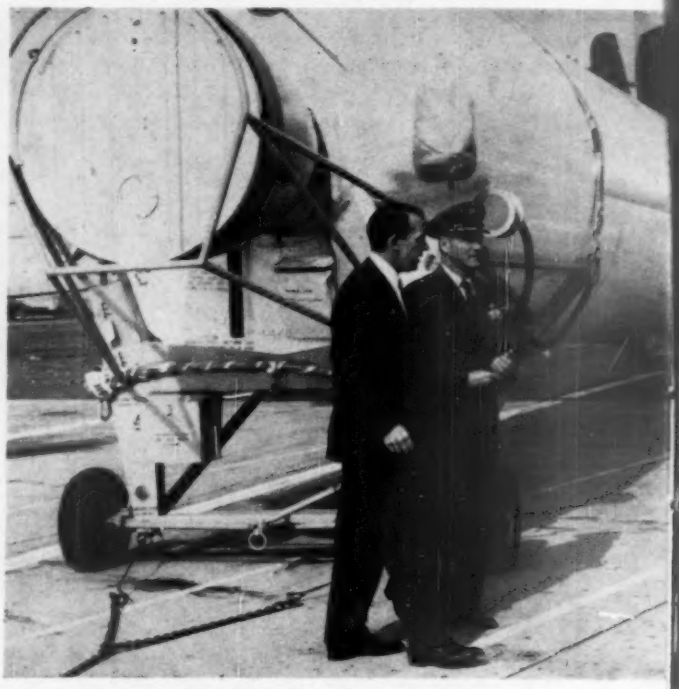
In the event, our departure from Dover was delayed for several hours, initially because of snow and ice on the runways, and later because of engine unserviceability. Once airborne, cruising speed was 200 knots true and our initial altitude 8,000 ft., although we climbed above 12,000 later in the flight to cross the mountains. The journey was not as uncomfortable as might be expected; although the aircraft is unpressurized and very noisy, it has an excellent heating system.

Our route was via Dover - Baltimore - Pittsburgh - Dayton - Indianapolis - St. Louis - Springfield - Neosho - Tulsa - Amarillo - Albuquerque. Although there is a time difference which stretches the length of the day by three hours, because of our late departure it was dark when we reached California. This prevented our landing at Santa Monica, where U.S.A.F. night landings are forbidden because of the difficult approach and relatively short runway. We thus diverted to Norton A.F.B. at San Bernardino, some 70 miles from Santa Monica.

Next morning—Monday, March 7—we were due to leave early for Santa Monica, but this was impossible because of mist and haze, a typical Californian phenomenon, which cut visibility from the air. As a result, I was able to look around Norton A.F.B. and learn something about its work, which plays a vital rôle in Thor, Atlas and Titan logistics. In addition it is responsible for the modification and overhaul of U.S.A.F. aircraft including the F-102 and C-133.

Norton is a base of Air Materiel Command. Known as San Bernardino Air Materiel Area, or SBMA for short, it is commanded by Maj.-Gen. Ben I. Funk. "Executive management responsibility" for the Thor was transferred to SBMA from Air Research and Development Command on January 1 this year, signifying that the missile is now regarded as being beyond its R. and D. phase. The supply and maintenance responsibility for Thor is now vested in SBMA.

At Norton, an electronic data processing system using an IBM 705 computer plays a major rôle in supporting the Thor missile bases in Britain; the computer accounts for 35,000 Thor parts. The system keeps track of spares requirements and is also used to check on their location and distribution. The computer centre is linked via a high-speed communications system with Thor bases in England, the major missile contractors, weapon-system storage sites, Air Materiel Command depots and other U.S.A.F. installations.



Donald Douglas, Jnr., and Maj.-Gen. B. I. Funk who is responsible for Thor logistic support in the U.S.

The R.A.F. has three liaison officers at Norton. One of them told me that considerable experience has now been gained of the spares requirements for the Thor system. Some modifications are still being made, but in general these are only to ensure the continued serviceability of missiles at launching sites.

These modifications are not needed to improve the flight performance of the missile. For example, nine Thors in Britain were recently grounded by corrosion in the pin motors of the erector gear; modifications have now been made to prevent water seeping into these motors.

On the operational side, one of the main differences between Thors at Feltwell and at the other three British bases is that Feltwell Thors have Rocketdyne MB-3-7 engines. The other Thors in Britain have the higher-thrust MB-3-9 engine.

The Thor ground-support equipment demands 80% of the maintenance effort devoted to the weapon-system; its complexity makes for some problems. Unserviceability of a relay in the launch-control trailer might ground three missiles.

So far as the missile itself is concerned, the guidance system is the most critical item and has to be maintained at a constant temperature of 165° F., with an allowable variation of only 7° F. above or below this value.

The lives of some Thor components have been increased

The Globemaster disgorges its missile payload at North Luffenham to complete the 60th Thor delivery.

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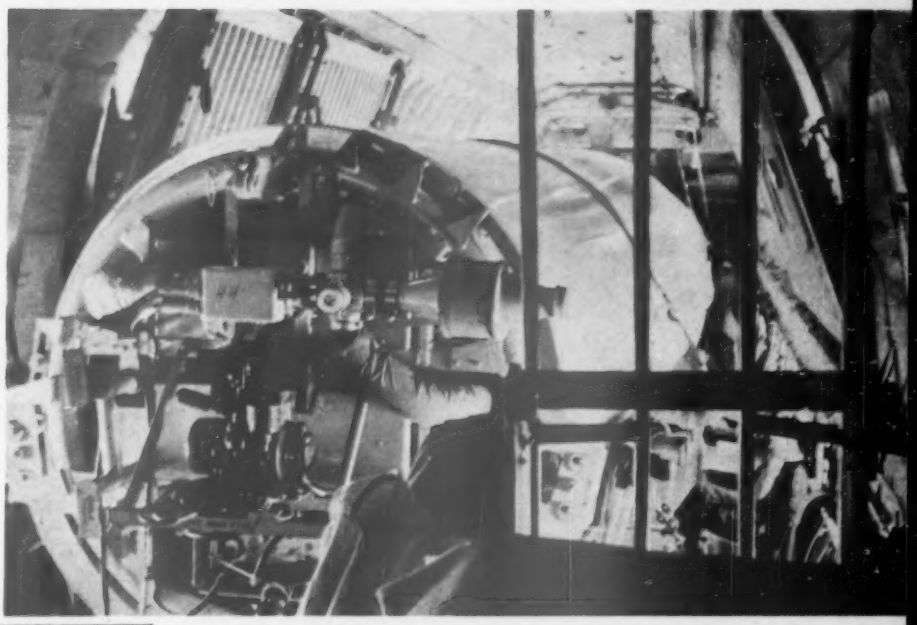


Right, although a comparatively light load for the C-124, a single Thor occupies much of the space in the capacious hold. Attached to the nose of the Thor can be seen the small motor-generator set which supplies current for gyro temperature control when the missile is being towed.

Below, Air Vice-Marshal M. H. Dwyer, A.O.C. No. 3 Group (right), representing the A.O.C.-in-C. Bomber Command, Air Marshal Sir Kenneth Cross, receives a presentation plaque commemorating delivery of the last Thor from the U.S. Making the presentation is Col. C. A. Peterson, U.S.A.F. plant representative at Douglas, Santa Monica.

following operating experience; for example, the life of the flight controller was increased recently from 200 to 1,000 hours. It might well take several years of simulated count-downs for this life to be exceeded.

On to Santa Monica

We left Norton soon after midday on March 7 for the short flight through mist to Clover Field, the Douglas airfield at Santa Monica. Because this airfield has no aids, the standard procedure is to make an instrument approach to Los Angeles International Airport, and then to overfly the main runway at 500 ft. and break off right for Clover Field.

The approach involves much low flying over the built-up area of Los Angeles; the runway end is on a bank and the approach is rather like coming in to land on an aircraft carrier. Several months ago a C-124 undershot slightly on the approach and wiped off its undercarriage on the runway lip.

Next morning, Tuesday, March 8, the Thor was loaded into the C-124 to the accompaniment of much photography. Donald Douglas, Jnr., and Maj.-Gen Funk were on hand to watch the departure; a plaque commemorating British deployment of Thors was handed over by Gen. Funk to Col. Clair A. Peterson, U.S.A.F. plant representative at Douglas, who was to take it with him to England for presentation to Air Marshal Sir Kenneth Cross, the A.O.C.-in-C. of Bomber Command.

The Thor was towed out with two-wheeled dollies attached to its front and rear; it was a complete missile lacking only its nose-cone and warhead. A small petrol motor-generator set was attached to the nose to supply 115-volt 400-cycle AC current to the heaters for the guidance gyros.

The somewhat tricky business of loading the missile took under 30 minutes. It was winched slowly nose-first up the ramp into the aircraft by a cable which passed round pulleys at the rear of the fuselage; a fork-lift truck was attached to the rear dolly to arrest progress if necessary. When the front dolly was just beyond the transition point between the ramp and the level floor of the C-124, its wheels were jacked to raise the missile and prevent its underside striking the floor of the ramp.

Winching then continued until the rear dolly wheels were just behind the transition point, when the nose of the missile was lowered to its original position. When the missile was inside the aircraft it was locked in position with chains attached to tie-down fittings. The power supply for the gyro heaters was then plugged into an external supply.

Most of the Thors delivered to England have been flown out of Santa Monica, but Thor ground-support equipment and missiles weighing 8,320 tons in all have been flown from Long Beach. Because of the short runway at Santa Monica, our aircraft did not refuel there; we took off relatively lightly loaded at 10.45 for a 35-minute flight to March A.F.B., where we fuelled for the transcontinental flight to Dover A.F.B.

Among passengers in the aircraft was Col. Peterson and a technical representative from A.C. Spark Plug. Known as the "birdwatcher," his task was to ensure that at all times power was supplied to the heaters for the Thor's guidance-system gyros. In flight this was provided by the aircraft's power system; its 28-volt DC supply was inverted to give the 400-cycle 115-volt AC current needed.

On the ground at the stops *en route*, power was supplied from an external source. If power failed in flight, the petrol motor-generator set could be used—as it was for the last 45 minutes before landing at North Luffenham, because of rectifier failure.

March A.F.B., where we refuelled before leaving California is a Strategic Air Command base; B-47s were scattered around in profusion—about 40 or more of them. From here we took off for the 12½-hr. flight across the U.S. to Dover A.F.B., following the route flown on the way out. As already mentioned there is a three-hour time difference between California and Dover; in climate the change is immense, we flew from Californian sun to Delaware ice, snow and frost.

We finally left Dover at 11.45 local time on March 9 with a new crew, bound for Goose Air Base in Labrador, which we reached after a 6 hr. 5 min. flight. It was dark with a blustering wind and snow flurries; after 2 hr. 15 min. on the ground we took off for North Luffenham, which we reached after an 11 hr. 15 min. flight. Here once again photographers were much in evidence. The aircraft was greeted by Air Vice-Marshal M. H. Dwyer, A.O.C. No. 3 Group, Bomber Command, who received the plaque from Col. Peterson on behalf of Air Marshal Cross, and the Thor was unloaded.

So ended an impressively smooth delivery flight, a tribute to the MATS organization which has lost no Thors, or their equipment, during 677 flights to Britain. The occasion was also a landmark in the Thor programme—rarely before can a revolutionary new weapon have been developed and put into service in just over four years. The 60th and last R.A.F. Thor arrived in Britain just four years and three months after the go-ahead was given for the development of this IRBM.

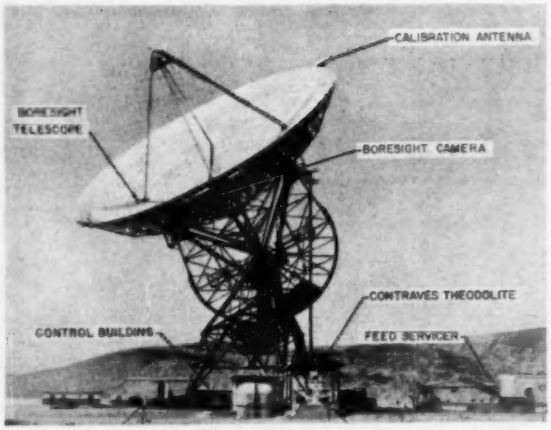
Space Radar for Woomera

INCREASING use of Woomera in international space programmes is foreshadowed by the news that the United States is to erect an 85-ft.-diameter radio-telescope at the range later this year. It is hoped to have the instrument in operation by October, when the United States expects to launch a deep-space probe from Cape Canaveral. In conjunction with a similar instrument at Goldstone Lake, California, and the Jodrell Bank instrument in this country, the basis will thus be established of a World-wide tracking network.

The Woomera radio-telescope will be linked directly with the Jet Propulsion Laboratory Computing Centre in Pasadena, to which tracking information will be relayed by teleprinter seconds after the instrument receives signals from the probe. There the data will be analysed to provide rapid and precise information for the accurate determination of the vehicle path and precise acquisition information for other tracking stations.

Under the terms of the agreement the United States will provide the necessary electronic equipment, costing about £1,600,000, while Australia provides the site and assists in the equipment's operation and maintenance. Australian scientists will be able to use the facility for their own independent scientific investigations when it is not being used in U.S. tracking operations.

Before the work of installing the radio-telescope begins at Woomera in June, five Australian scientists are to study a similar instrument in the United States, and later five American scientists from the Jet Propulsion Laboratory in Pasadena will visit Woomera to help organize the assembly work.



The existing space-probe tracking facility at Goldstone Lake, California.

Following the installation of this equipment, and additional tracking facilities at Perth and Woomera for Project Mercury, the U.S. manned satellite programme, Australia will be a key tracking centre for a whole range of space operations. There is, of course, already in existence at Woomera a Minitrack station and a Baker-Nunn camera optical tracking station, both of which have already done valuable work in tracking artificial satellites.

Project "Aurora"

PROPOSALS for adapting existing rockets for space-research have been submitted by the Swedish Interplanetary Society to Sweden's National Committee for Space Research. Objectives of the programme would be research into cosmic radiation, the Northern Lights, luminous night clouds, meteorology, geodesy, space environment tests with "matter and living organisms," aerodynamic tests, and the transmission of radio-waves.

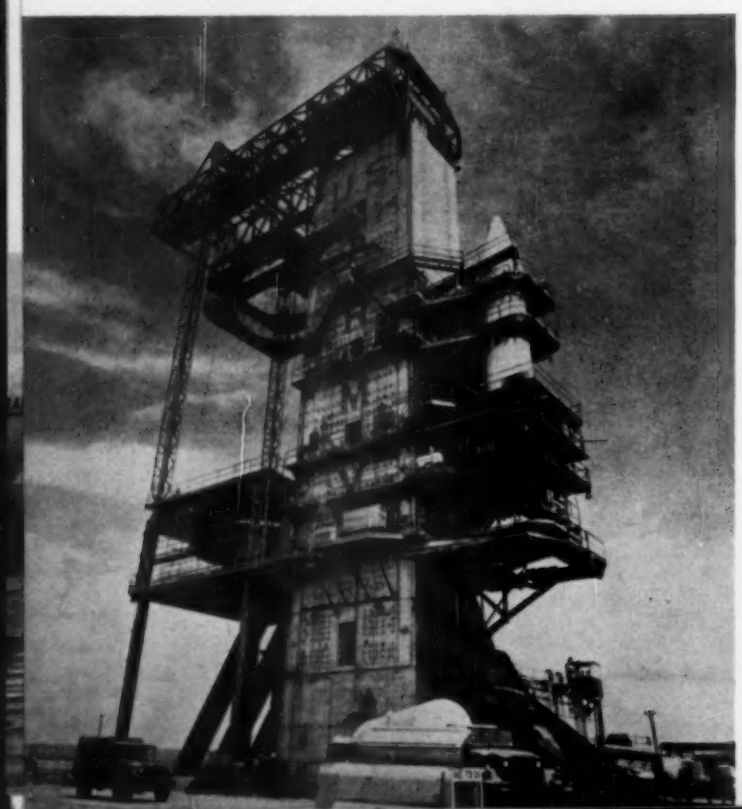
The initiative for the project was taken by Mr. Åke Hjertstrand of the Swedish Interplanetary Society in 1958. In preparing the feasibility studies, involving the development of three different step-rockets, he was assisted by Mr. Lars Henrik Ågren, and more recently a group headed by Mr. Olle Ljungström of the Swedish Saab aircraft company has taken an active part in the project.

Three variants of rockets having different altitude ranges are specified on the basis of combinations of both liquid and solid-propellent rockets. According to the Swedish Interplanetary Society, all essential components have already been developed in Sweden for other purposes, including the liquid-propellent Svenska Flygmotor VR3 rocket engine of over 4,500-lb. s.t.

The HR-1 version would reach an altitude of 248 miles with an 11-lb. research payload; alternatively, it would climb 192 miles with a payload of 55 lb. Payloads of 55 to 252 lb. of equipment could be carried to a height of between 70 and 114 miles by the HR-2, while HR-3 could send 11-33 lb. to an altitude of 40 to 50 miles.

Instrument recovery would be achieved by parachute, and the liquid-propellent stages of the HR-1 and HR-2 would also be recovered by parachute with the prospect of being re-used. The rockets would be unguided, being fitted with fins and spin-stabilized. Peak accelerations are described as moderate, about 7.5*g* for HR-1 and HR-2.

According to the Swedish Society, test launchings could begin within 1½ years after the rockets have been ordered into production.



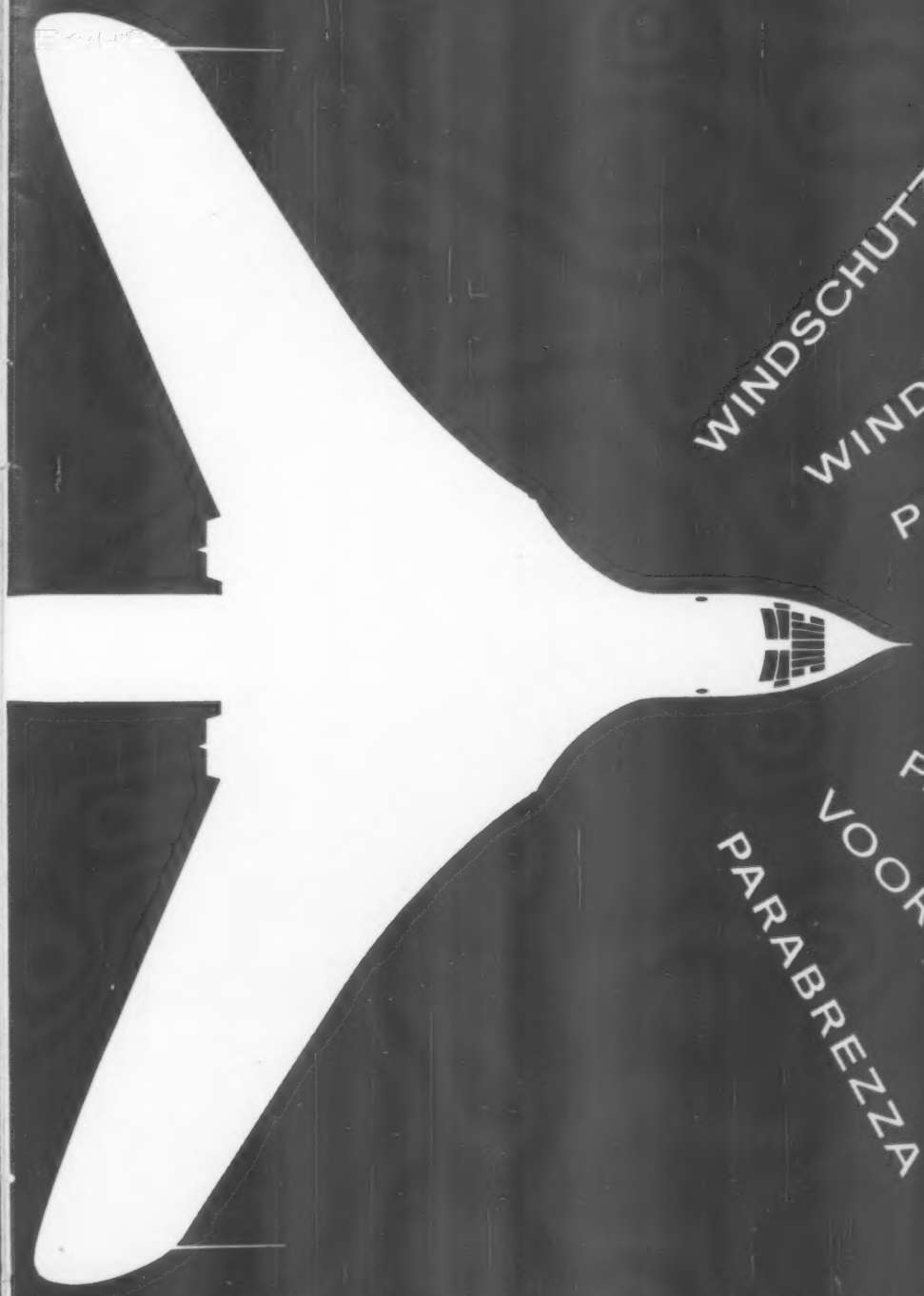
At Redstone Arsenal, Alabama, the ABMA test-tower, originally used for static testing of Jupiter IRBMs, has been heightened to 175-ft. and heavily reinforced (left of picture) to accommodate the massive Saturn booster of 1.5-million lb. s.t.

Electric Balloon?

A RUSSIAN scientist, Prof. Georgy Pokrovsky, has suggested that the Earth's positive electric field may be used "to assist the flight of balloons," according to Moscow Radio. The idea is to construct a very large balloon of polymeric film, the walls of which would carry a negative charge. This negative charge, in the presence of the positive field of the Earth, would make the balloon practically weightless, says the professor.

Apparently, the balloon would be launched into space at a height of a few hundred miles and ejected when the carrier rocket was travelling parallel with the Earth's surface. There it would inflate into the form of a giant telescope—"bigger than any on Earth"—for use in stellar astronomy. Telescope and balloon would be made of a special thin film which could be packaged and sent up in the launching rocket, filled with gas, and given a static charge.

It would appear that the balloon is not intended to go into orbit as a satellite but to "float" in space after release. Although this new principle of flight may seem fantastic, said Professor Pokrovsky, it is highly attractive as a long-term proposition.



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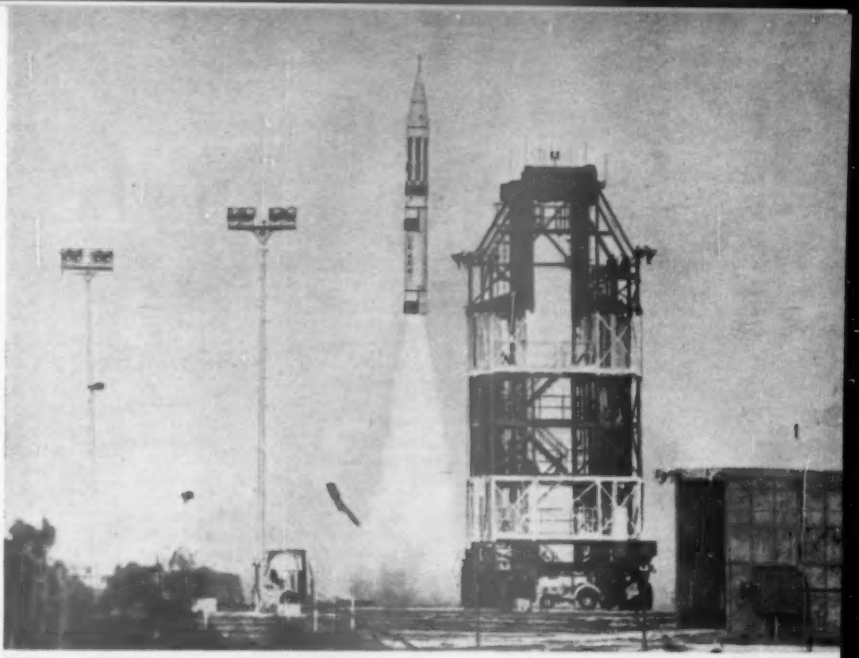
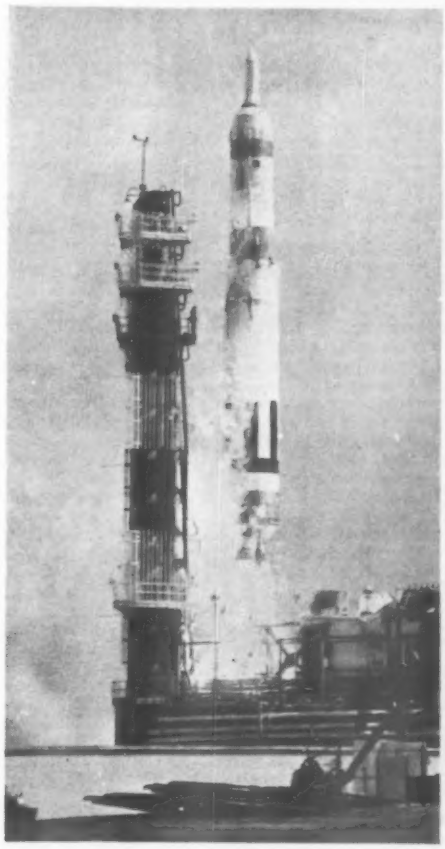
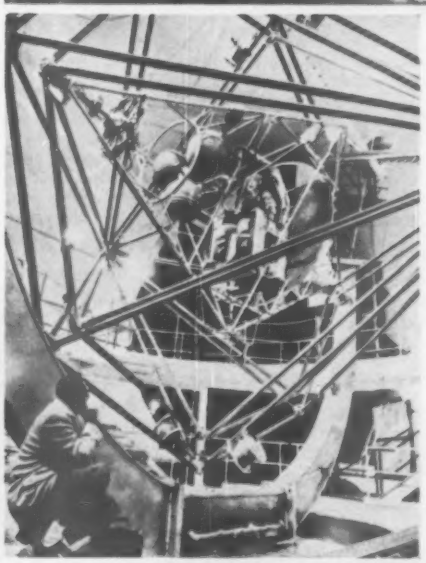
Research in Pictures





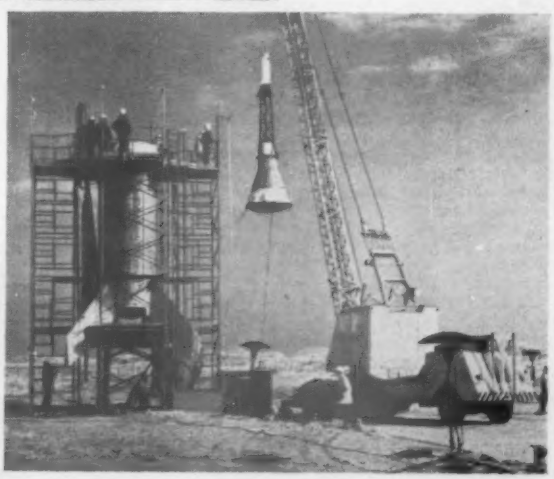
TITAN AGAIN.—Off on a successful 5,000-mile test-flight downrange from Cape Canaveral goes a two-stage Martin Titan ICBM. Note the new ablative-type nose-cone.



SOLID PUNCH.—Above, under development as a mobile field weapon, the U.S. Army's 32-ft., two-stage, solid-propellent, Martin Pershing rises from its transporter-launcher at the Cape Canaveral launching base.

SPACE RIG. — Left, this complicated structure is installed in the Multiple Axis Space Test Inertia Facility at NASA's Lewis Research Center near Cleveland. Here engineers are running a disorientation test with a pilot at the controls of a three-axis "space-capsule" simulator. By means of nitrogen-gas pressure jets, the rig can be made to simulate all possible flight attitudes in pitch, roll and yaw.

BOOST-GLIDE.—Below, hypersonic rocket-boosted gliders capable of orbital flight are under study at the NASA Langley Research Center in Virginia. Left to right, a basic flow and heat-transfer wing, a basic wing-body combination, and two re-entry vehicles. Model tests in the 11-in. hypersonic wind-tunnel are made in air up to Mach 10.0 and in helium up to Mach 18.0.



Increasing use is being made of the NASA facility at Wallops Island, Virginia, for space-experiments. Here a full-size development model of the Mercury space-capsule is lifted aboard a Little Joe boost rocket preparatory to a test of the emergency escape system.

Rockets and Satellites Discussed

NEW information concerning Britain's progress in upper atmosphere and space research was given at the Royal Aeronautical Society's all-day discussion on "Vehicle and instrumentation problems in upper air research" on March 11.

Opening the morning session, SIR HARRIE MASSEY, F.R.S., began by stressing the continuing importance of high-altitude rocket sounding as distinct from satellite experiments. A satellite, he said, would not have a very long lifetime if the perigee of the orbit were not greater than 125 miles. Below this level, it was necessary to use vertical sounding rockets, and there were years of useful work ahead in the observation, interpretation and analysis of the highly variable quantities associated with these regions.

There was certainly a wide range of scientific problems to study by going outside the Earth's atmosphere, and more distant journeys were also possible. Sir Harrie thought, however, that there was no great need for manned spaceflight for purely scientific purposes. Information could be got automatically with varying degrees of difficulty.

Although most scientific information from satellites and space-probes could be obtained by telemetry without vehicle recovery, there were occasions when it was desirable to recover research equipment for physical examination.

In vertical rocket soundings, Sir Harrie said it was important that measurements should be made under the same conditions as if the rocket were not present. Droplets of rocket propellent could seriously prejudice instrument measurements in the ionosphere, and thus it became necessary to isolate the instruments from the rocket, in some cases even to separate the instrument head from the propulsion section.

The Raven Rocket Motor

Dealing with the Skylark rocket, MR. J. F. HAZELL, of the R.A.E., paid high tribute to R.P.E., Westcott, designers of the Raven rocket motor. This, the first large solid rocket motor to be used in an upper atmosphere research vehicle, had been very successful in the large number of firings that had already occurred. It employed a composite case-bondible plastic propellent with a specific impulse of 177 sec. and produced a thrust of 12,000 lb. for about 30 minutes. The Rocket Propulsion Establishment, Westcott, were responsible for the design, filling and test of the motor, while Bristol-Weston (now Bristol-Aerojet) had been contracted to produce the motor case. The propellent itself, comprising ammonium perchlorate, ammonium picrate, and polyisobutylene, was manufactured by the Royal Ordnance Factory.

A weight breakdown of Skylark showed that, for a launching mass of 2,550 lb., 2,200 lb. was contributed by the Raven motor (including 1,800 lb. propellent), 100 lb. by the fin assembly, 100 lb. by structure in the rocket head, and 150 lb. by payload.

Rockets launched near the vertical with low accelerations, Mr. Hazell said, present very serious dispersion problems. These had been overcome in Skylark by careful attention to jet and aerodynamic misalignment of the motor and vehicle, special techniques for wind corrections, and the use of a tall launching tower. An unexpected roll resonance phenomenon had been encountered which could lead to instability towards end of burning unless the roll rate was kept to a very low level.

Apart from the use of a 465-Mc/s telemetry sender, the instrument head could be recovered by parachute. This permitted the use of tape and mirror galvanometer systems, or experiments requiring X-ray plates or star photographs, for example. The flexibility of Skylark was apparent from the wide variety of probe techniques it could employ, including spikes for ion probes and magnetometers, jettisoned nose-cones to expose photometers or cameras, ejection of devices such as the Birmingham ion cage on a 100-ft. cable, and deployment of grenades, "window," and sodium vapour.

An even wider range of experiments would soon be possible when an R.A.E.-developed pneumatic head three-axis stabilization system was introduced. The air-jets for this would provide 5-lb. thrusts to stabilize the separated head above an altitude of 200,000 ft. in conjunction with a gyro-reference package. Control could be exercised within 2 or 3 deg.

Skylark would shortly be fitted with a high-thrust boost motor which was expected to increase the altitude range to 120 to 130 miles. Filling in the details of the booster, DR. W. R. MAXWELL (R.P.E., Westcott) said it had been named "Cuckoo" because its function was to "kick the Raven out of its nest."

Operating for about four seconds, the Cuckoo booster had a total impulse of 81,000-lb./sec., or about one-quarter that of the early Raven motor. Its cost was £700-£800 in comparison with £3,000 for Raven.

Next, DR. R. L. F. BOYD of University College, London, considered the large range of physical experiments proposed for the British rocket and satellite programmes. Already, the existing experiments with Skylark covered studies of the neutral atmosphere including the ejection of radar chaff ("window"), grenades, photochemical and scattering materials for wind, temperature and density measurements. The ionosphere was studied by ion chamber, dielectric probe, Langmuir probe and radio propagation.

Further experiments, Dr. Boyd said, would include sphere drop tests, possibly with Black Knight, to determine air density above 100 km. by drag measurement using satellite tracking techniques. Black Knight would also be used in testing instruments developed for the joint U.K./U.S. Scout satellite.

Astronomy in the ultra-violet was also being undertaken by sky scanning experiments and photography. A sky photo experiment would involve the point sources of U.V. stars, requiring the use of a stabilized nose-cone.

An All-British Satellite Launcher

Finally, MR. E. C. CORNFORD, Guided Weapons Dept., R.A.E., outlined the design studies which his department were making for an all-British satellite launcher.

The four-stage American Scout rocket would put a payload of 150 lb. into orbit at 300 miles. This was too small to permit stabilization for astronomical purpose in which there was considerable scientific interest in this country.

The R.A.E. studies had therefore been based on the requirement for stabilization, and in addition to this, and the launching vehicle itself, consideration was being given to the design of sensing instruments, long-term power supplies, data recovery systems, and heat-balance equipment.

A de Havilland Blue Streak stripped of its military equipment would comprise the launching vehicle's first stage, the second stage being a Saunders-Roe Black Knight; it was desirable, however, to replace the latter's existing propellent tanks with shorter tanks of increased diameter.

Investigation had been made into the mode of operation of the respective rocket stages. After separation of Black Knight from the Blue Streak booster, it would be necessary to interrupt burning of the Black Knight engine to permit an intervening coasting phase, during which the vehicle would rise to satellite altitude under momentum before a final burst of thrust injected it into orbit. This raised the problem of controlling the attitude of Black Knight and relighting the engine when the vehicle was in conditions of weightlessness.

It was therefore proposed to use a third stage employing "vernier" rocket motors of perhaps 500- to 1,000-lb. thrust which would be lit before cut-off of the Black Knight engine. Separation would then occur and the third stage would stabilize along the local horizon rising to orbital height under continuous low thrust.

Extensive performance calculations at R.A.E. had shown the following possibilities. A payload of 1,750 lb. could be injected into a circular orbit at 300 miles; a 400-500-lb. payload could enter an eccentric orbit with a perigee of 300 miles and an apogee of 8,000 miles; and a 200-lb. payload could enter a highly eccentric orbit with a perigee of 300 miles and an apogee of 100,000 miles.

Taking up the prospects of the vernier-type final stage, MR. LYONS (R.A.E.) said there was a marked improvement in performance by going to continuous thrust. For one thing, the use of small engines instead of large engines was a useful weight-saving measure, and the long thrust period would permit appropriate corrections to be made from ground observations as the vehicle entered orbit.

A problem that had to be watched concerned the possibility of the Black Knight bumping the separated vernier stage after separation. Although the Black Knight engine would be cut off, residual thrust due to outgassing of the propellents could conceivably cause the vehicle to encroach on the final stage immediately after separation. In trials of Black Knight at Woomera, thrust measurements had been obtained at altitudes much greater than the normal cut-off height, between 60 and 80 miles, indicating this phenomenon.

Winding up the discussion, MR. A. V. CLEAVER said that although we were obviously right to take up the American offer of Scout to orbit our instruments, the present position was not wholly satisfactory. We had the opportunity of giving a lead to the Commonwealth and Europe as an alternative to that offered by the United States and Russia. He hoped very soon that the R.A.E. design studies would be allowed to progress beyond the present stage to that of actual hardware.—K.W.G.

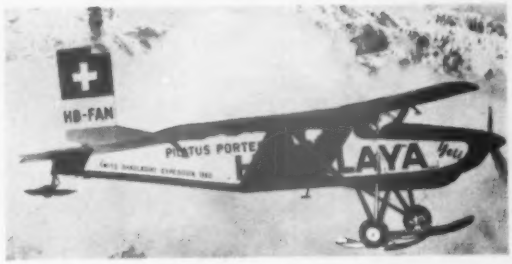
Aviation News in General

SIKORSKY ORDER.—A $45 million order for turbine-powered HSS-2 helicopters, spare parts and associated items was awarded to the Sikorsky Aircraft Division of United Aircraft Corporation by the U.S. Navy on March 8. Deliveries will start this December, and end in December, 1961. The HSS-2 first flew in March, 1959, and is already in production for the U.S. Navy as an anti-submarine weapons system.

HOPE FOR FLYING-BOATS?—Japan may become the last country to put a new military flying-boat design into production, according to present plans. A large anti-submarine patrol boat is wanted for the Maritime Self-Defense Force to replace Neptunes and Sentinels. Kawanishi (builders of the Wartime Emily) are likely to obtain the contract to deliver 26 between 1963 and 1970.

B.L.E.U. COMETS.—Two de Havilland Comet 2Es are to be used for further trials of the leader-cable blind-landing system at the B.L.E.U., Bedford, where more than 4,000 blind landings have been made in trials with a Varsity and Canberra.

P.166 RELIABILITY. — Papuan Air Transport (Patair) has now completed 600 flying hours with its Piaggio P.166 transport; no defects in either airframe or powerplant showed up during the four months of operation.



SNOWMAN.—Seen over the Swiss Alps is this Pilatus Porter which has been specially constructed by the Pilatus Aircraft Co., for the forthcoming Swiss expedition to Dhaulagiri in the Himalayas. It has been named "Yeti" after the famed "abominable snowman."

RYAN BACKLOG.—From San Diego comes news that Ryan Aeronautical has a backlog of $30 million worth of orders for production Q-2C transonic Firebee target missiles for the U.S.A.F. and a $50 million backlog for APN-122 Doppler radar equipment for the U.S.N.

COMET FLYING. — In the past 12 months the 10 Comet 2s of No. 216 Squadron, Transport Command, have flown more than 10,000 hours, bringing their total flying time up to 26,000 hours.

VTOL EJECTION.—In the recent accident to the Ryan VZ-3RY Vertiplane VTOL research aircraft the pilot, Glen Stinnett, escaped at 1,000 ft. with the aid of a Martin-Baker Mk. VRN.4 ejection seat. The VRN.4 is one of a range of three VTOL seats (the others are in the Short S.C.1 and the Dornier Do. 29) which differ only slightly from the standard Martin-Baker Mk. 4 seats.

HERALD TOUR.—The first production Handley Page Herald was to leave England on March 16 for demonstrations in Africa and South America. It will visit Ghana and Nigeria and then go on to Brazil, Uruguay and Argentina, where a Herald prototype was demonstrated last year. It will be flown by Capt. R. Shilton, seconded from Silver City.

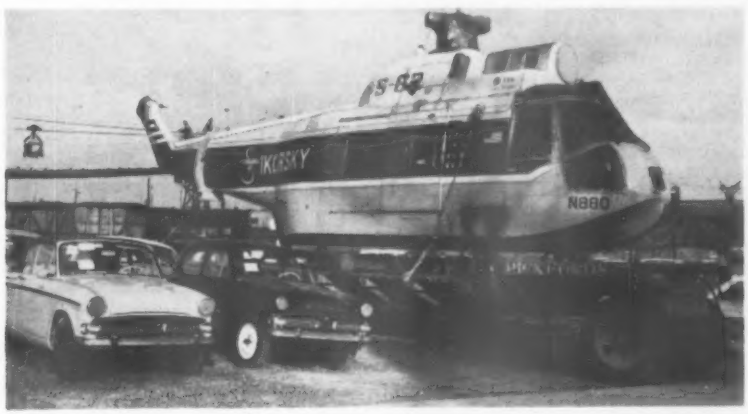
INDONESIAN OTTERS. — Three more Otter landplanes have been supplied to AURI, the Indonesian Air Force. One landplane and three amphibious Otters had previously been supplied.

CRANFIELD SYMPOSIUM. — A Flight Test Instrumentation Symposium is to be held at the College of Aeronautics on April 7-9, 1960. Details about this symposium can be obtained from the Department of Flight, College of Aeronautics, Cranfield, Bletchley, Bucks.

DROPPED CATCH.—According to Lt. Gen. B. A. Schriever, the re-entry capsule ejected from Discoverer VIII last November re-entered "over the heads" of the recovery aircraft patrolling in the Pacific. Two earlier capsules made "programmed re-entries into the atmosphere, as confirmed by visual sightings and other evidence."

BOOST-GLIDING.—It is reported that the U.S.A.F. hope to test large-scale models of Dyna-Soar using the Chance Vought Scout as a booster.

ION-DRIVE.—Good progress with an "ion rocket engine" has been reported from NASA's Lewis Electric Propulsion Laboratory in Cleveland, Ohio. Models of the engine have already run for more than 50 hours.



TOUR COMPLETED.—The T58-powered Sikorsky S-62 helicopter has recently completed an extensive European sales tour. It was shipped from Avonmouth to New York earlier this month.

Commercial Aviation Affairs

THE FOURTH A.A. COMET.—Aerolineas Argentinas took delivery of its fourth Comet 4 early this month; it flew from Hatfield to Dakar (2,720 miles) in 5 hr. 51 min. on the first stage of its delivery flight on March 8. Named "Arco Iris" (Rainbow), it differs from the first three Argentine Comets in having thrust reversers. Two more are to be delivered in the near future.

QANTAS-T.A.I. AGREE.—Agreement has now been reached between France and Australia for a new air agreement which will permit Qantas to fly to Marseilles or Paris, and T.A.I. to fly to Sydney. T.A.I. started a service from Sydney to New Caledonia and the New Hebrides on March 14 and will open the Paris-Sydney-Los Angeles service in May. Qantas will also be given rights at Tahiti on its Pacific services and for a route to New Guinea through New Caledonia and the New Hebrides.

BRANIFF 720S. — Braniff International, which already has four Boeing 707-220s, is to purchase three 720s, with an option on a fourth. Interior decorations and seating will be identical with those of the 707s, with 50 de luxe and 56 coach-class seats. The contract, now being negotiated, calls for deliveries in February, April and September, 1961, and for delivery of the optional aircraft in May, 1962.

LUFTHANSA PLANS.—On March 17, Lufthansa was to put its Boeing 707-420s into service on the route from Frankfurt to New York. The aircraft will go on to the Chicago route and a with Rolls-Royce Conway by-pass turbojets, and will carry 24 first-class and 120 economy-class passengers. On April 1, the New York service will increase to daily frequency; in mid-May the 707s will go on to the Chicago route and a Frankfurt-San Francisco route.

NIPPON F-27s?—All Nippon Airways is reported to be planning the purchase of three Fokker F-27s. Tentative approval has been given by the Japanese Civil Aviation Bureau.

SWISSAIR JETS.—Caravelles leased from S.A.S. and seating 20 first- and 50 tourist-class passengers will be put into service by Swissair on May 21 between London and Zurich. In mid-July Caravelles will be introduced on routes to the Middle East and Scandinavia, and in mid-August to Madrid, Lisbon and Vienna. On May 30, Swissair will put the DC-8 (28 first- and 92 economy-class seats) into service to New York.

EUROPEAN ELECTRAS.—K.L.M. is introducing Electras on many new routes between now and the end of March. They include Amsterdam - Frankfurt - Athens - Cairo - Khartoum, Amsterdam - Dusseldorf - Vienna - Sofia - Athens - Beirut - Damascus, Amsterdam - Rome - Athens-Cairo-Abadan and Amsterdam-Rome-Tel Aviv. On April 1, the Electra will be put on to the Moscow route.

ORKNEY TAXI.—Caledonian Flying Services of Glasgow is offering a trial air taxi service for Orkney in April and May. With a four-seat Thruxton Jackaroo (converted Tiger Moth) the service will operate on demand between Kirkwall and five landing places in the northern islands.

P.A.L. FRIENDSHIPS. — The two F-27s for Philippine Air Lines were delivered at Amsterdam on March 4 and the first was ferried to Manila on March 8. For domestic operation, these F-27s are 40-seaters and are the first built by Fokker for an airline with weather radar.

EAST EUROPE POOL? — Airline chiefs from Bulgaria, Czechoslovakia, East Germany, Hungary, Poland and Rumania have been meeting to consider ways of eliminating competition between east European airlines. The competition from Western airlines with modern equipment may be countered by a rationalization of services by these airlines, which have been promised new aircraft by Russia.

FLIGHT TEST.—The re-engined Lockheed JetStar prototype with four JT-12 engines is now in flight test and is being used to speed up F.A.A. certification of the production aircraft, the first of which is due to fly in July.

I. T. DECLINE.—A general decrease of about 20% has been reported in inclusive tour bookings throughout Britain this year. Fewer flights will be operated than originally planned.

RULING OUT NOISE. — Noise-control rules for civil and military aircraft at Los Angeles International will become effective on April 4. The rules proposed by the F.A.A. were discussed in our issue of December 18, 1959, and have now been confirmed in SR438, with the exception of a proposed restriction on night operations under certain wind conditions. This rule has been dropped on the grounds that it would seriously inhibit the commercial utilization of jet aircraft. Similar regulations will soon be issued for New York and Washington.

B.O.A.C. BOOM. — Bookings on B.O.A.C. services from London to New York for the period from February to July are 52% higher than last year, and 37% higher in the reverse direction. The number of economy-class passengers has increased by 90%. B.O.A.C. has already sold 18,000 more seats on North Atlantic services than at this time last year.

RESEARCH BUREAU NEWS. — Olympic Airways has become the fourteenth European airline to join the Air Research Bureau, which held its annual general assembly in Rome on March 4 under the chairmanship of Count Nicilo Carandini.

ACCIDENT REPORT.—The commission of inquiry into the accident to an Avianca Constellation at Jamaica on January 21 has reported that a piloting error resulted in a heavy landing, which caused structural failure of the port wing, followed by fire. Contributing factors were given as crew fatigue and the default of the supervisory and advisory authorities responsible for the overall conduct of Avianca's flight operations. Thirty-seven persons were killed in the crash; five of the crew, including Capt. J. Duque, survived.

MUNICH HEARING.—The independent body set up by the M.T.C.A. last June to review the representations made by Capt. Thain about the accident at Munich in February, 1958, will meet on April 4. The public hearing will be at No. 10 Carlton House Terrace.

News About People

A.O.C. BOSCOMBE DOWN. — Air Cdre. J. F. Roulston, C.B.E., D.S.O., D.F.C., has been appointed Air Officer Commanding of the Aircraft and Armament Experimental Establishment, Boscombe Down. He has been Task Group Commander of the Reinforcement Party at Christmas Island since February, 1958.

EAGLE APPOINTMENT.—Mr. A. Hudson has been appointed assistant to the president of Eagle Airways (Bermuda). Formerly senior vice-president of Colonial Airlines, Mr. Hudson has been associated with the Princess Hotel of Bermuda in recent years.

AIRWORK APPOINTMENT. — Sqn. Ldr. J. P. Tyszko, for several years chief test pilot of Airwork, Ltd., has been appointed Cessna sales manager by Airwork Services, Ltd., the U.K. agents for all Cessna lightplanes. Mr. D. M. Roberts has been appointed engineering manager at Airwork Services main base at Hurn.

I.MECH.E. PRIZE.—The 1959 James Clayton Prize of the Institution of Mechanical Engineers has been awarded to Mr. C. B. Dicksee, M.I.Mech.E., for his pioneering and subsequent development and research work on the high-speed compression-ignition engine. During the War Mr. Dicksee was in charge of turbojet combustion chamber research and development at the de Havilland Engine Co., Ltd.

NEW EXHIBIT.—Martin-Baker Aircraft Ltd., has recently presented the Science Museum, London, with the ejection seat used for the first live ejection test in this country, and the cockpit of the Meteor used for the first tests.

TWIN PIONEER CRASH.—Captain D. A. Templeton was killed when the Twin Pioneer he was demonstrating crashed on take-off at Johat, in Assam, on March 10. Also killed was an Indian Airlines Corporation pilot on board.

Personal Flying

FULL details have lately become available on the remarkable long-distance non-stop flights by Max Conrad last year, which established new records for light aeroplanes of 7,668 miles in the 3,858-6,615-lb. category (Class C.I.d) and 6,959 miles in the 2,204-3,858-lb. category (Class C.I.c).

These almost unbelievable achievements were performed in the same aircraft, a Piper Comanche, which in June, for the first record, had a 250-b.h.p. Lycoming O-540 flat-six engine, and in November, a 180-b.h.p. Lycoming O-360 flat-four. They followed many other long over-water flights Conrad had undertaken as a ferry pilot for Pipers, including more than 50 transatlantic crossings, a 4,400-mile trip from New York to Sicily in a Comanche in 1958, and a crossing of the Pacific to Seoul, Korea, in an Apache, during the same year.

For the two record flights, he limbered up by flying the Comanche from the United States to Casablanca, Morocco, after lightening the aircraft by removing the starter, installing a smaller generator and eliminating external drag features. Six additional fuel tanks installed in the cabin brought the total fuel capacity for the first record to 433 Imp. gal., and increased the gross weight to about 5,000 lb., compared with the normal 2,800 lb. One of the tanks also formed the seat on which Conrad was to sit for more than 58¼ hr. of flying.

As the Lycoming uses so little oil, no extra capacity was thought necessary and the existing tank was merely filled to 13 instead of 12 quarts. Much of the modification work on the Comanche was done by Conrad himself, since he is a qualified ground engineer. To cope with the greatly increased weight, the tyre pressures were doubled, to 50 p.s.i., and the oleo legs additionally given extra pressure.

Take-off on Casablanca's 6,000-ft. runway was completed in 4,000 ft., in an 8-knot cross-wind. Initial climb, over Casablanca town, was 500 ft./min. and the entire flight was undertaken between about 50 and 2,500 ft. The Comanche was an Auto Flite model with ARC ADF, Collins VHF and Sunair HF equipment. Its average consumption throughout the flight was only 6¾ Imp. gal. per hour, and the Comanche landed at Los Angeles with an untouched 25 gal. in the port wing tank.

The second record, which began on November 24 at Casablanca, in the re-engined Comanche N110LF ("Let's Fly"), exceeded the previous C.I.c record, achieved in 1948 by the late Bill Odom, by 40%. The 180-b.h.p. engine was 110 lb. lighter than the 250 Lycoming, and one of the fuselage tanks was removed, leaving a total internal capacity of 303.4 Imp. gal. At 3,838 lb., the Comanche was then only about 50% over its normal gross weight.

A Piper Comanche of the type flown by Max Conrad on his long-distance record flights.

To avoid excessively long taxi-ing, Max Conrad took off from Casablanca in a very slight tail-wind, after a run of about 3,300 ft., unsticking at 90 m.p.h. at less than full throttle. He subsequently cruised at 124 m.p.h., the minimum practical speed at that weight, and progressively reduced to 100 m.p.h. as fuel was burnt. Cruising height over the sea varied between 100 ft. during the day, and 500 ft. at night, to take advantage of the so-called T-effect, which the Americans claim exists in a narrow band close to the sea and requires less power to fly in.

Unlike the first Comanche record flight, which included circling for four hours at night to avoid heavy storms over the Gulf of Mexico, weather conditions on the second trip were perfect, except for adverse winds in the same region. These necessitated a diversion towards Miami, and a climb to 4,000 ft. to clear the terrain. Landing was subsequently made at El Paso, with 38 Imp. gal. of fuel remaining in the wing tanks. Towards the end of the flight, fuel consumption had fallen to less than 4 Imp. gal. an hour at 100 m.p.h., and the respective overall averages for the flight were 4.7 g.p.h. for 123 m.p.h. ground-speed.

Gliding Notes

by Dr. A. E. Slater

FROM Wichita, Kansas, comes a letter from Mr. Harry C. Higgins, who was stimulated by the article "Soaring in the Himalayas," by Brennig James in THE AEROPLANE AND ASTRONAUTICS for Feb. 5. Mr. Higgins fears that the Himalayan pilots may be troubled by the same difficulty that he and his friends had to guard against when planning to soar over Mt. Rainier, 14,408 ft. high, near the north-west corner of the United States.

Dense forest surrounds the mountain, so the major risk was that of running out of lift with no safe landing within gliding distance. So they concocted a plan. The glider was to have "radio communication with redundant sets to ensure reliability, a sliding canopy which could be opened with ease in flight, and a cleat arranged on the outside of the glider within reach of the pilot."

The tug, after launching the glider, would hang around in case it was needed for rescue work. If it was, then it would "overtake the glider and pass slightly below and to one side." The glider pilot would then catch the towline and "belay it to the cleat."

While this would obviously be better than nothing, it sounds rather like belaying the "sheet," which is the sailors' name for the rope controlling a mainsail. It takes a second or two to undo it in an emergency and in those critical seconds much can happen.

To avoid the pilot being knocked out by the usual ironmongery at the end of a towrope, Mr. Higgins suggests a non-metallic ring and a small drogue. But he and his friends never got as far as trying out this scheme, so he hopes the British pilots will test it to see if it works.

Some years ago, Mr. Higgins recalls, a light aeroplane landed on Mt. Rainier, but its pilot could not restart the engine. So he slid down a glacier until he gained flying speed, and then spent an hour soaring in the "hill lift" before landing on a frozen lake.

* * *

"CLOSED-CIRCUIT flying is probably the highest form of the soaring art and the most satisfying." So said Geoffrey Stephenson in introducing a discussion on the subject at the London Gliding Club on Feb. 27. The first need, he said, is the correct state of mind; if you begin by keeping up-wind so as to be able to turn back, you almost certainly will turn back. And it is best to aim for a task that seems a little higher than the weather would justify, because "you nearly always do better than you expected."

It is useful to have triangular courses of the three stock sizes worked out on a map, so that when the right day arrives for either a 100-, 200- or 300-km. triangle, you are ready for it. But you must not expect to break a record if the wind exceeds 10 knots.

During an aero-tow launch, you should note the character of the low thermals as you pass through them; if there are no good ones below 2,000 ft., then you must keep above 2,000 ft. throughout the subsequent flight.

Stephenson confessed that he seldom flies between thermals as fast as the theoretical best speed, which is calculated from thermal strengths. He knows only two meteorologists who can forecast thermal strengths reliably; and anyway, Jack Hands pointed out, different thermals can go up at different speeds on the same day.

Cloud streets can upset theory, as the late Frank Foster showed when he broke the 100-km. triangle record by going round faster than was theoretically possible, just by using cloud streets. It pays, Stephenson recommended, to keep below a street rather than climb into it, as he discovered when forced to do so when crossing airways. For one thing, you cannot see the lie of the clouds if you go inside.

* * *

LASHAM GLIDING SOCIETY announces an "At Home" on Saturday, May 21, at the airfield, which is between Alton and Basingstoke, in case you don't know. Before that comes the Easter Taskflying Rally of the Midland Gliding Club at the Long Mynd from April 15 to 19.

Correspondence

Non-inflammable Fluids

WITH reference to a letter in your issue of Feb. 5 concerning requirements for hydraulic fluid, I would like to draw your attention to the fact that a low inflammable silicone fluid having a very wide temperature range has now been developed. This fluid has the chemical inertness normally associated with silicones.

This material is the subject of a Development Contract and one of the aircraft companies in this country is at present testing it.

Long Ditton, Surrey. D. A. P. FITZ-GERALD.

No. 39 Squadron, R.F.C.

I AM writing a book about the Royal Flying Corps in the Great War, 1914-18, and I particularly want to get in touch with former members of No. 39 Squadron, R.F.C., who served with the squadron in 1916. Will any readers who were with the squadron at that time get in touch with me, please?

KENNETH POOLMAN.
(Author of "The Kelly," "Faith, Hope and Charity," etc.)

Farnham, Surrey

[Letters sent to this office will be forwarded.—ED.]

Air Commodore J. S. Chick in Cairo

IN your issue of Jan. 29 (p. 126) G.D. omitted one short but—to the Middle East—important chapter in the life of Johnny Chick. This was the period from 1946 to 1948 when he was Head of the R.A.F. Advisory Mission in Cairo. During that immediate post-War period he endeared himself to all in Cairo with whom he came in contact both in the field of aviation and of sport, particularly, however, to all the officers and other ranks of the Egyptian Air Force. I would say that he was the most popular British officer who ever served in Cairo.

On learning of the death of Johnny Chick I sent cables to his Egyptian Air Force friends who have since cabled me back their expressions of deep and sincere sympathy and requested me to convey these to his family.

Beirut, Lebanon. E. P. J. RYAN.

Air Traffic Control in the U.K.

I NOTE the report (THE AEROPLANE AND ASTRONAUTICS dated Feb. 26 last, p. 251) of the presentation of the Hunt Trophy for 1959 by the Guild of Air Traffic Control Officers, to the Royal Air Force for its foresight in forming the United Kingdom Air Traffic Control Service.

I should be grateful if you or any of your readers could inform me on what date the United Kingdom Air Traffic Control Service was formed.

In view of the fact that this trophy is presented for the most outstanding contribution to Air Traffic Control and therefore added safety in the air during 1959, I feel that those interested in aviation and in particular those civil air traffic controllers who have been striving to control air traffic for the past 25 to 30 years under the apparent misapprehension that they were the United Kingdom Air Traffic Control Service have been kept in the dark. I feel also that this noteworthy and outstanding contribution to safety in the air during 1959 has not had the publicity it deserves.

Bishop's Waltham, Hants. R. T. HALLIWELL.

[Our correspondent's point of view is understandable. The U.K.A.T.C. was formed on June 16, 1959.—ED.]

Weather at Biggin Hill

MOST pilots will agree that weather is still a governing factor in all flights of any distance. They take for granted that aerodromes where constant flying takes place will have a competent observer to note significant changes and report any serious deterioration to pilots *en route* and they expect a forecast for the duration of the flight and conditions at their destination.

Pilots contemplating visiting the Battle of Britain Aerodrome are well advised to be very wary in this matter. Little help can be expected from the responsible Ministry. What information is available emanates from Gatwick some 15 miles distant and some few hundred feet different in level. This forecast moreover covers the entire S.E. Area and in certain synoptic conditions is as much use to Biggin Hill as one for the Fiji Isles.

Attention has been drawn to the almost complete lack of normal facilities, i.e., Customs, radio, etc., suffered by the operators here, although they were promised all these when ejected from Croydon. Now, too, I would like to emphasize this meteorological hazard. A recent experience convinces me that it is only a matter of time before some major incident occurs because of it.

I was a passenger in a Proctor with an experienced pilot returning from the Continent. Reports received for Gatwick and Southend showed reasonable conditions and a forecast for Biggin Hill for the period 13.00-18.00 hrs. was similar. Nevertheless Southend to Biggin Hill at about 16.30 hrs. was 8/8 at 400 ft. Vis. ½ mile with strong gusts and rain. In the dusk and in these conditions some difficulty was experienced in locating the aerodrome and I feel sure that a stranger to the area would not have done so.

Subsequent inquiry at Gatwick elicited the fact that those responsible were quite unaware of this deterioration.

For an aerodrome within 15 miles of London such inadequacies are reprehensible, to say the least.

Keston, Kent. J. BODEM.

Groundabout

Aural Augury. Ice in the sky can be more localized than you might think, according to a hand-out I've received. It tells of a safety device to warn pilots of "earial icing conditions."

*

Slow and Easy. A Canberra plans to voyage from England to Australia this summer—in 21 days. And I mean voyage, for this Canberra is a ship. With her on the maiden trip will travel Russell Brockbank, whose drawings delight the readers of *The Motor* and of *Punch*, of which he's the art editor. And I thought we aviation journalists got all the good trips!

*

We Are Not Alone. I see that some passengers who wanted to alight at A were prevented by the weather from doing so, were taken on to B and later taken back to A, arriving there a day later than scheduled. Airline passengers? No, sir, they were travellers from America on the "Queen Mary," which was prevented, not for the first time, by high winds from docking at Cherbourg. They were taken on to Southampton, then back to Cherbourg in another ship. As a variation on "If you've time to spare, go by air" how about "Take a tip, don't go by ship"?

*

How's That Again? A reader writes to assure me that this column is "the funniest thing in THE AEROPLANE AND ASTRONAUTICS." H'm. Still, it's preferable to the other letter which said "I always read your column—much better than counting sheep."

*

From My Favourite Line Book

Hairy Old Master Signaller, pinning on medals for big parade: "If they have any more wars I'm going to get round-shouldered."

*

"What's on today?
-a Station Exercise?"

by Wren

Industry Record

Snow and Ice Removal

A different approach to runway snow removal problems is revealed in the Snow Locust, a new machine produced by Mobile Jet Dispersals, Ltd., of Newcastle upon Tyne. By applying the principle of controlled heat through primary and secondary sources, the manufacturers state, it is capable of cutting a 9-ft. path through a 6-in. snow-drift at a speed of 4 m.p.h.

Whilst the snow dispersing equipment can be mounted onto almost any chassis, the prototype tests have been satisfactorily completed with the equipment installed on a small four-wheel-drive utility vehicle. The ancillaries are operated from a counter-shaft driven from the rear power take-off.

Mounted on, and pivoting about, brackets welded directly onto the forward chassis frame, a working head directs heat forward and downwards onto the snow/ice surface, via a variable number of Swirlamiser oil burners. Each burner has a heat output from 40,000 to 120,000 B.Th.U./hr. at a temperature of 1,200° F. A cowl is fitted to each burner to obtain heat concentration and eliminate risk of blowback during windy operating conditions. The fuel used is 35 sec. gas oil, which is pump-fed from a tank mounted at the rear of the vehicle.

Air for combustion is fed from a compressor operating at a pre-set pressure feeding air via flexible hose to the front working head. Lift and tilt of the working head (providing a suitable relationship with a snow surface) is obtained through a single hydraulic ram, centrally mounted at the front of the vehicle.

In addition to the primary heating source provided by the oil burners, a secondary cycle is supplied—the purpose of which is to condense and "de-steam" vapour arising from the application of direct heat to the snow/ice surface. A fan mounted at the rear of the vehicle feeds air via ducting and flexible hoses to the top of the rocking head. Emitted from vents at the top of the working head, the air is sufficiently heated to remove the steam which would otherwise obstruct the operator's vision.

The Snow Locust, a new machine manufactured by Mobile Jet Dispersals, Ltd., for dispersing ice and snow.

A.T.C. Radar Simulators

Recently developed and now in production by Redifon, Ltd., is a new ground-to-air radar simulator designed for *ab initio*, advanced and refresher training for A.T.C. radar controllers and operators of civil and military radars.

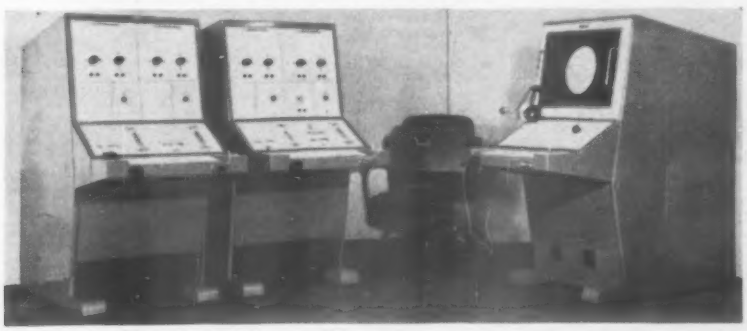
One of a series produced by the company, this new simulator comprises target consoles, each of which contains two units, and display consoles, each of which contains one display unit. The standard equipment comprises four targets and one display, although extra target and display consoles can be added as required. All power units, computers and so on, are fitted inside these units and there is no other external equipment.

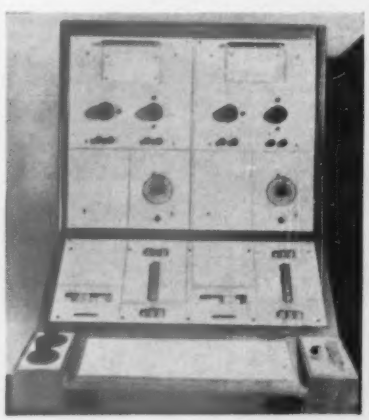
The target consoles have a simple and logical layout with primary and secondary control areas for each target. On the primary control area are push-buttons for controlling the rate of turn and direction of the target, together with fade, orbit and linear control for speed. There are six pre-set rates of turn from rate ¼ to rate four.

Required heading and actual heading dials are fitted on the secondary control area; the turning on to a new pre-selected heading is automatic. Target position information is presented in Northings and Eastings in counter form, together with a bearing and distance indicator. Automatic target positioning and resetting controls are also fitted.

Although not installed in the first simulator unit, height equipment can be included in the system. This comprises an altitude indicator; rate of climb/descent buttons similar to the rate-of-turn controls; and automatic change of height controls.

Other facilities include a six-channel intercom. system, wind setting and a target "freezing" switch. The display console is based on the Ministry of Aviation Type 38 unit and the simulator can be employed with live radar displays.





The new Redifon ground-to-air radar simulator equipment; it comprises two target consoles and a display console. On the target consoles there are lower primary and upper secondary control areas for two targets; height equipment can be fitted in the empty panels on the left-hand side of each unit.

Engine and Airframe Components

H. K. Porter & Cie, S.A., international subsidiary of H. K. Porter Co., Inc., Pittsburgh, has acquired an interest in the King Aircraft Corpn. of Glasgow. The latter, which will continue to be operated by its present team, manufactures aircraft engine and airframe components including special lines of fasteners, clamps, couplings and filters. Recently King Aircraft has undertaken diversification of its production lines, adding flexible metallic hose and plastic pipe and hose to its range of components.

Precision Bearings

E.M.O. Instrumentation, Ltd., of Bracknell, have introduced a completely revised catalogue of their high-precision ball bearings. Following the company's recent formation of an association with The Barden Corporation of the United States, this new publication is more comprehensive than earlier issues and reflects the advances that have been achieved in production and design. Containing data on a number of new bearings, the catalogue includes a considerable amount of space devoted to engineering technique and information.

Electronic Equipment Cooling

A new cooling system for electronic equipment, recently announced by Vickers Incorporated, Division of Sperry Rand Corpn., utilizes fluorinated hydrocarbon fluids which act as stable dielectric and heat-transfer agents. The new package system dissipates an input of 47 kW. with a unit weight of only 2 lb. per dissipated kilowatt. The system's dry weight is 74 lb.

This is an active system—as compared with a passive, ablative-type cooling technique—which employs a centrifugal pump that circulates fluid first through a liquid-to-air heat-exchanger core, and

Industry Record . . . .

then through the electronic gear. The fluid is circulated at rates as high as 52 g.p.m. to maintain turbulent flow for maximum heat-transfer effectiveness. An output pressure of approximately 100 p.s.i. overcomes the inherent resistances to flow found in the coolant passages of electronic equipment and holds the fluid in a state of maximum dielectric strength.

Survival Equipment

A further order for inflatable liferafts and lifejackets worth £37,000 has been received by the R.F.D. Co., Ltd., of Godalming, from Air France. The rafts, each of 26-person capacity, will equip the airline's new Boeing 707 fleet. Rafts of this type are now in use with 15 of the World's major airlines.

New G.P.U. for B.O.A.C.

Vernons Industries of Liverpool have recently delivered to B.O.A.C. the first of four 400-cycle 100-kVA. electric/electric ground power units which have a unique type of motor/alternator. The set is being used by Qantas with their 707s until the B.O.A.C. Boeings arrive.

This brushless alternator is driven by a brushless, self-starting salient-pole synchronous motor. Both the motor and alternator, together with the centrifugal fan and excitation equipment, are built on to a single shaft which turns in two lightly loaded bearings. This machine is stated by the manufacturers to be the first of this particular type in the World and uses the Vernon-designed rapid-response transistorized voltage-control system. The G.P.U. has simplified controls with push-button automatic starting, transistorized frequency protection and thermal overload protection.

One of the four new ground power units supplied by Vernons Industries, Ltd., for use with B.O.A.C.'s 707s. It is being used by Qantas until the Corporation's Boeings are delivered.

It has a 100/120-kVA., 200-v., 400-cycle, 3-phase output at 0.75/1.0 power factor and 200% overload at 0.4 power factor. The trolley on which the unit is mounted has solid-tyred wheels and Bramber Flexitor suspension units. The complete set is covered by a weatherproof detachable canopy of Zintect steel sheet.

Far East Maintenance

Hong Kong Aircraft Engineering Co., Ltd., at Kai Tak Airport have appointed Killick Martin and Co., Ltd., Dunster House, 20 Mark Lane, London, E.C.3, as their agents for the United Kingdom and Europe At present employing some 1,400 personnel and operating an airframe overhaul section with a maximum work capacity of 125,000 man-hours per month, the company has recently undertaken some new contracts. These include base inspections for R.A.F. Hastings of the Far East Air Force and a DC-4 overhaul programme for the U.S.A.F., involving 2,300-2,400 hours per aircraft.

Aluminium Stockholders

W. Wilson and Sons (London), Ltd., 114 Nightingale Road, London, N.22, increased their authorized share capital to £25,000 on January 1 this year. They are occupying larger premises in a new building at the same address, where Wilson Alloys, Ltd., and Sherringham Metals, Ltd., also operate.

Aeronautical Apprenticeships

A summary of apprentice training at the de Havilland companies in the United Kingdom is given in a new brochure entitled "De Havilland Apprenticeship."

After dealing with the work of the aircraft, engine and propeller companies, the publication covers the opportunities and apprenticeship schemes available. These include craft, engineering and commercial apprenticeships, scholarships, undergraduate and vacation training, and postgraduate training. Conditions of service and welfare are also described.

Aviation Calendar

March 14

London.—British Institution of Radio Engineers Radar Group discussion on "Short Range Navigational Aids," at the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, W.1, at 18.30 hrs.

March 15

Glasgow.—R.Ae.S. Glasgow Branch lecture, "Lessons Learned from Aircraft Accidents," by J. G. M. Pardoe at the Royal College of Science and Technology, at 19.15 hrs.

London.—R.Ae.S. lecture, "Some Problems of Separated and Vortex Flow," by Prof. H. B. Squire in the Library, 4 Hamilton Place, W.1, at 19.00 hrs.

Salford.—Royal Technical College lecture, "Long Range Missiles," by A. K. Weaver, at the Royal Technical College, at 19.00 hrs.

March 16

Christchurch.—R.Ae.S. Christchurch Branch lecture, "Lighter than Air Aircraft," by the Rt. Hon. Lord Ventry at the King's Arms Hotel, at 19.30 hrs.

Coventry.—R.Ae.S. Coventry Branch lecture, "The Hovercraft," by G. H. Elsey in the Herbert Art Gallery, at 19.30 hrs.

London.—Aircraft Recognition Society lecture, "Aircraft of the Future," by J. A. Hamilton in the Library, 4 Hamilton Place, W.1, at 19.00 hrs.

London.—Royal United Service Institution lecture, "Rockets, Satellites and Military Thinking," by Sir Frederick Brundrett at the Institution, Whitehall, S.W.1, at 15.00 hrs.

Southampton.—R.Ae.S. Southampton Branch 7th Mitchell Memorial lecture by D. Keith-Lucas in the Engineering Lecture Theatre, University of Southampton, at 20.00 hrs.

March 17

Cowes.—R.Ae.S. I.o.W. Branch lecture, "Hovercraft," by C. S. Cockerell, in the Clubhouse, Saunders-Roe Sports and Social Club, Church Path, at 18.00 hrs.

London.—R.Ae.S. Main Lecture, "Supersonic Aircraft—Promise and Problems," by M. B. Morgan at the Institution of Mechanical Engineers, 1 Birdcage Walk, S.W.1, at 18.00 hrs.

March 18

London.—Institute of Navigation lecture, "The American Air Traffic Control Programme," by Hans Giesecke at the Royal Geographical Society, 1 Kensington Gore, S.W.7, at 17.15 hrs.

London.—R.Ae.S. Agricultural Aviation Group film evening in the Library, 4 Hamilton Place, W.1, at 19.00 hrs.

Wolverhampton.—R.Ae.S. Birmingham and Wolverhampton Branch president's night, by L. S. Greenland at H. M. Hobson, Ltd., at 19.30 hrs.

Company Notices

NEW COMPANIES

Gas Liquor (Northampton), Ltd. (650,004).—Private co. Reg. February 19. Cap. £100 in £1 shares. Objects: To carry on the business of manufacturers of and dealers in liquid gas for farming and agricultural spraying, fertilization and disinfestation; to employ carriers, aeroplanes, helicopters in connection therewith. Directors: Herbert J. Norman, Greystones, Astcote, Northampton; Kenneth J. Chick, 92 Birchfield Road, Northampton. Sec.: Shirley Hart. Reg. off.: Greystones, Astcote, Northampton.

Personal Plane Services, Ltd. (650,029).—Private co. Reg. February 19. Cap. £2,000 in £1 shares. Objects: To carry on the business of manufacturers of and dealers in aeroplanes, etc. Directors: Douglas Bianchi and Mrs. Edna M. Bianchi, both of 325 Staines Road, Ashford, Middx. Sec.: Edna M. Bianchi. Reg. off.: 325 Staines Road, Ashford, Middx.

Kidd-Kare Travel, Ltd. (650,267).—Private co. Reg. February 23. Cap. £1,000 in £1 shares. Objects: To organize, conduct and carry on transport services, trips, tours and excursions, etc. Directors: Stuart W. Pollard and Sylvia M. Pollard, both of 27 Tenterden Gardens, Hendon, N.W.4. Reg. off.: Room 10, Triumph House, 189 Regent St., W.1.

Westbury Motors, Ltd. (650,303).—Private co. Reg. February 23. Capital £3,000 in £1 shares. Objects: To carry on the business of motor, aeronautical, electrical, mechanical and general engineers. Directors: Cecil J. Pratt and Mrs. Lilian M. Pratt, both of 77 High Street, Westbury-on-Trym, Bristol. Sec.: Barbara E. Biggs. Reg. off.: 77 High Street, Westbury-on-Trym, Bristol.

INCREASES OF CAPITAL

K.D.G. Instruments, Ltd. (293,743). Audrey House, Ely Place, E.C.1. Increased by £35,000 in £1 shares, beyond the registered capital of £15,000.

General Precision Systems, Ltd. (426,402) (formerly Air Trainers Link, Ltd.). Aldermanbury House, Aldermanbury Square, E.C.2. Increased by £125,000 in £1 "B" ordinary shares, beyond the registered capital of £487,500.

New Patents

APPLICATIONS ACCEPTED

833,424.—**Rotol, Ltd.**—"Methods of producing electrical de-icing overshoes for airscrew blades, aerofoils and the like."—April 30, 1956. (May 3, 1955.)

Printed specifications of the above will be available on April 21, 1960, and the opposition period will expire on July 21, 1960.

833,726.—**Ramo - Wooldridge Corporation.**—"Collision indication system."—May 27, 1957. (May 28, 1956.)

833,738.—**Curtiss - Wright Corporation.**—"Aircraft training instruments for simulating attitude gyroscopes."—July 2, 1957. (July 9, 1956.)

833,730.—**Bristol Aircraft, Ltd.**—"Aircraft."—July 3, 1958. (June 6, 1957.)

Printed specifications of the above will be available on April 27, 1960, and the opposition period will expire on July 27, 1960.

Personal Notices

BIRTHS

Harries.—On February 28, to Patricia (*née* Pratt), wife of Flt. Lt. Kenneth Harries—a son.

Howard.—On February 29, at East Wing, The Manor, Coltishall, to Margaret (*née* Tattersall), wife of Flt. Lt. T. A. Howard—a daughter.

Parkes.—On March 3, at Peterborough, to Mavis, wife of Flt. Lt. Alan Parkes—a daughter.

Penny.—On February 29, at the Zachary Merton Maternity Hospital, Rustington, Sussex, to Vi (*née* Lloyd), wife of Flt. Lt. J. C. Penny—a son.

Watkin-Jones.—On March 5, at St. John's Hospital, Chelmsford, to Phil, wife of Sqn. Ldr. H. Watkin-Jones—a daughter.

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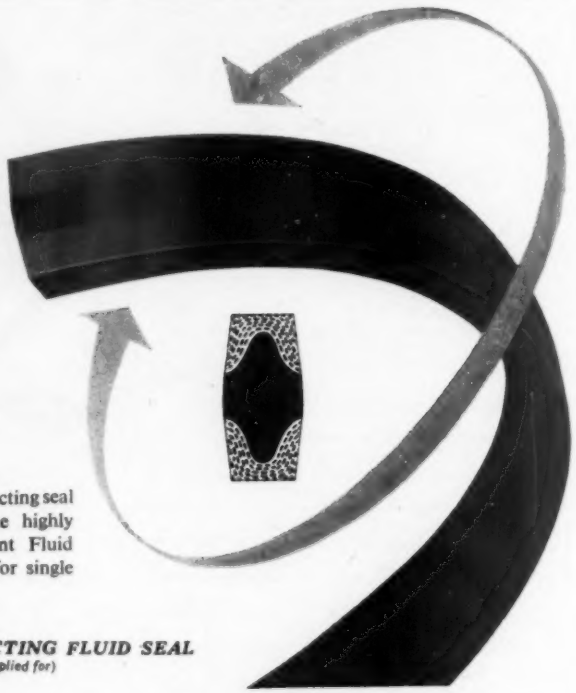

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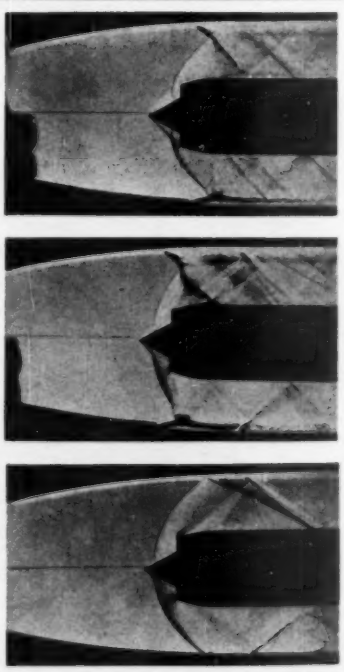

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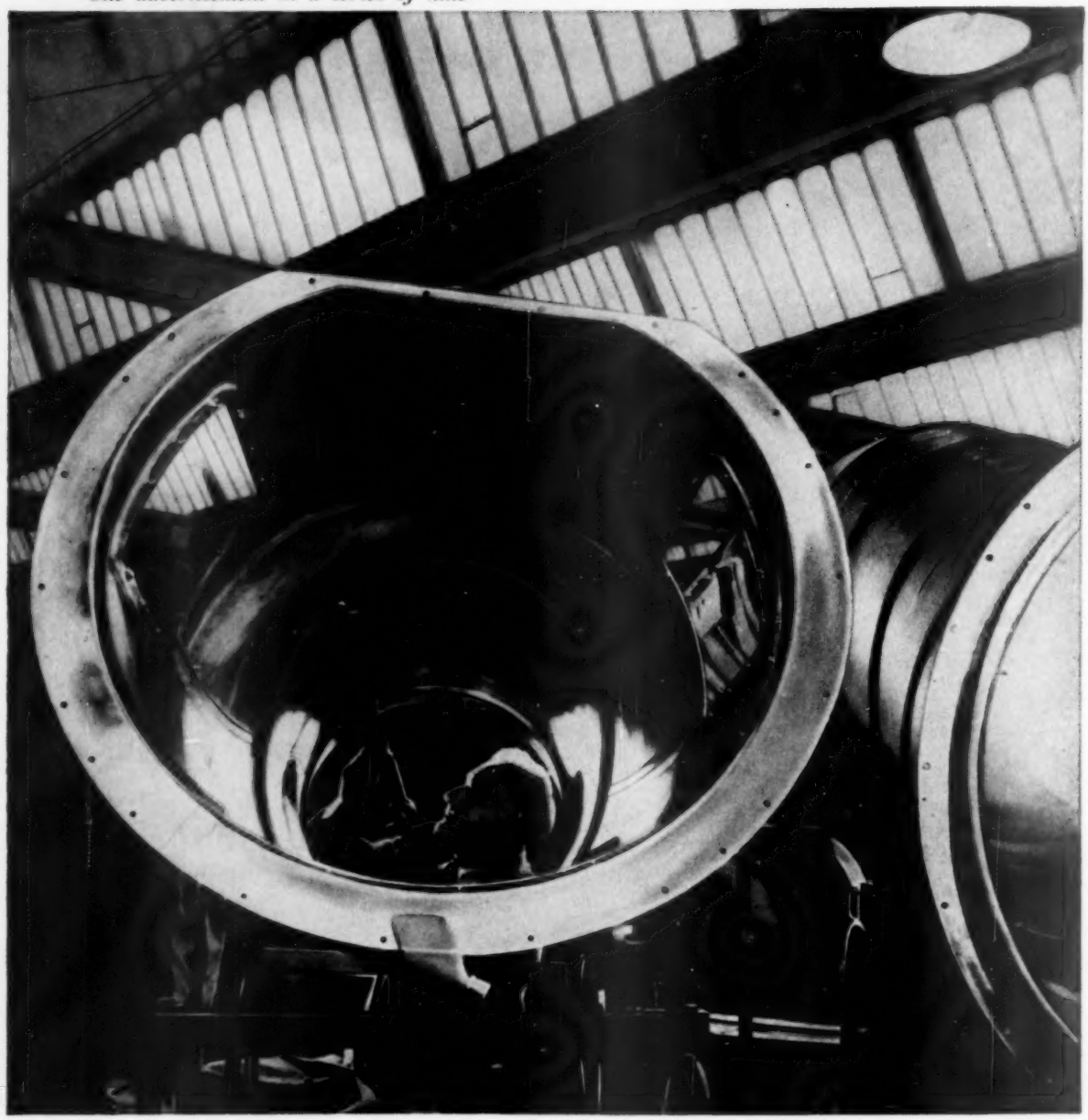

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